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Draft Environmental Impact Statement
for the
Proposed Expansion of Western Energy Company's
Rosebud Mine
into
Areas A and E

JUL 19 '77

STATE DOCUMENTS

Montana Department of State Lands
Helena, Montana
June 9, 1977

Submitted pursuant to
Montana Environmental Policy Act
Section 69-6504(6)(3)

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HELENA 59601

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June 15, 1977

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Western Energy Company's (WECO) Rosebud Coal Mine is located in Rosebud County, Montana adjacent to the community of Colstrip. Surface coal mining has occurred in the Colstrip vicinity since 1924.

A draft Environmental Impact Statement (EIS) for a proposed amendment to WECO's 1975 surface mining permit is being sent under separate cover. WECO is seeking to expand their mine in the existing mine areas entitled A and E. These areas are located 1/2 mile south, and 1/2 mile east of Colstrip, respectively. Specifically WECO wants to permit 1,844 acres - 656 in area A and 1,188 in area E.

This draft EIS represents a cooperative effort by the Department's Environmental Coordinators and the following consultants: Dames & Moore (physical), Olson-Elliott and Associates (biological), and Cummin Associates (socio-economic). Contents of the EIS are those required by the Montana Environmental Policy Act (MEPA), (Chapter 65, Title 69, R.C.M. 1947) and the Department's rules adopted pursuant to it (Title 26, Chapter 2, Subchapter 18 of MAC).

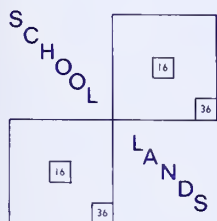
All materials submitted to the Department by WECO as part of their application for a permit pursuant to the requirements of the Montana Strip Mining and Reclamation Act (Chapter 10, Title 50, R.C.M. 1947) are on file and available for public review in the Department's offices.

This draft EIS is being distributed for public and agency review in compliance with MEPA and the MEPA rules. All comments should be submitted to the Environmental Coordinator, Department of State Lands, Capitol Station, Helena, MT, 59601, by July 15, 1977.

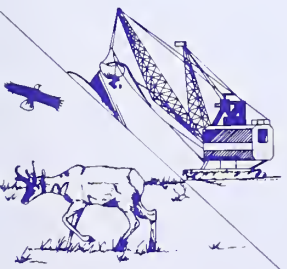
Sincerely,

BRACE HAYDEN
Environmental Coordinator
Department of State Lands

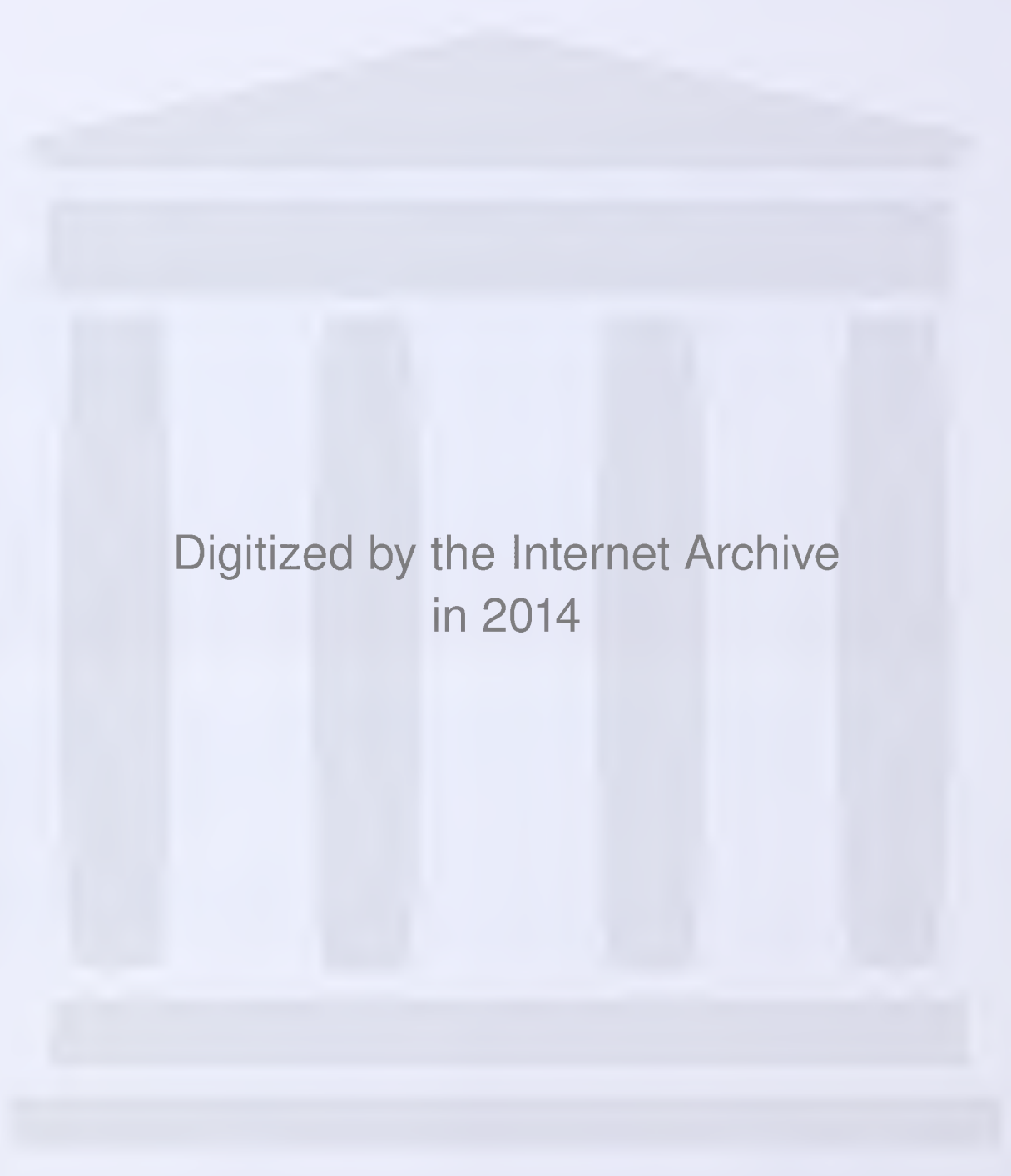
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I. Introduction

A. Location

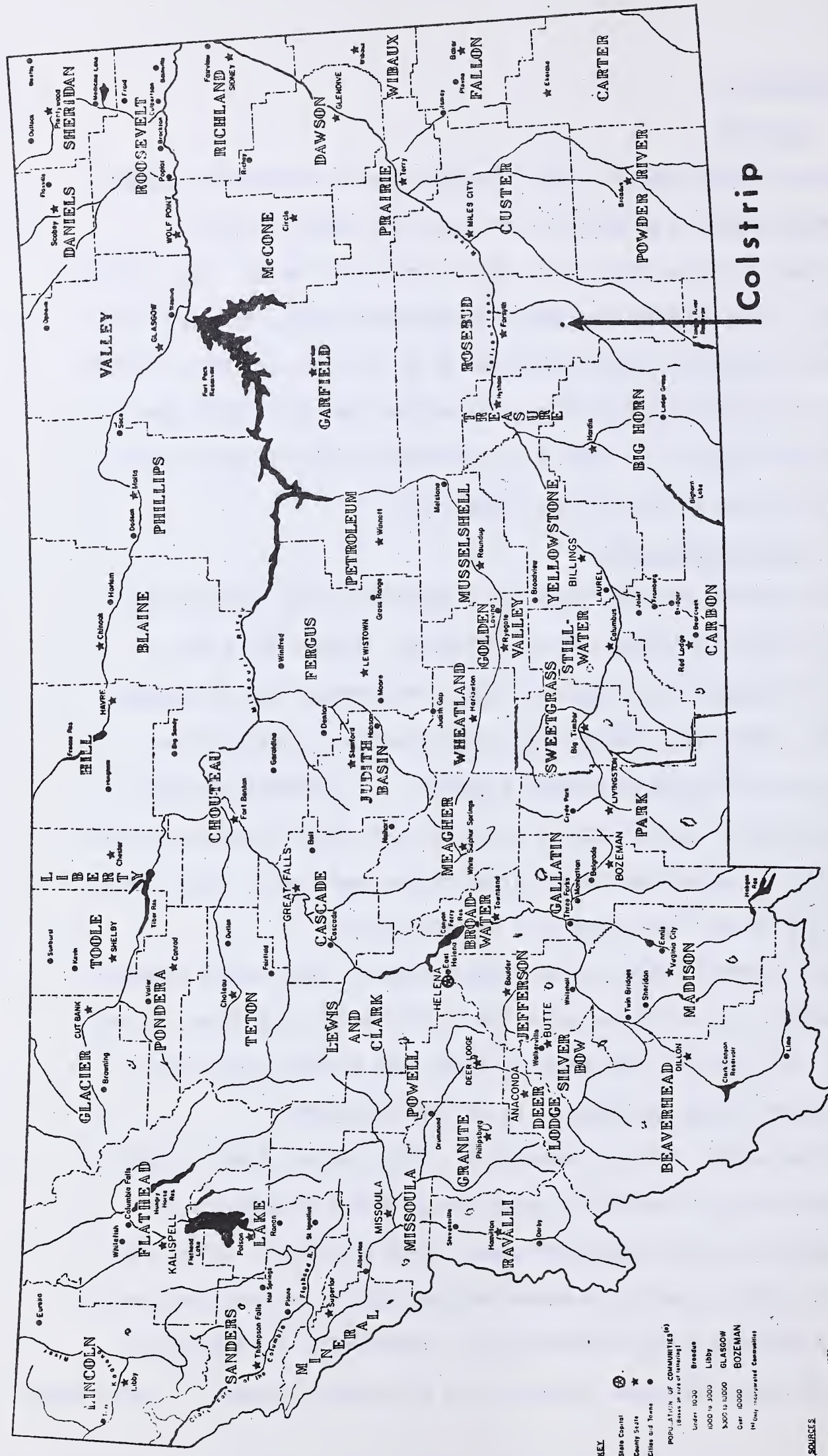
Western Energy Company's (WEC) Rosebud Mine is located in Rosebud County, Montana and is adjacent to the town of Colstrip (figure 1). Principal access to the mine is via state highway 315 which links Colstrip to Forsyth. For management purposes, Rosebud mine areas, both existing and future, have been divided into areas A, B, C, D, E, and Pit 6 (figure 2). Area A is approximately ½ mile south of the town of Colstrip and west of state highway 315. Area E is approximately ½ mile east of the town of Colstrip and east of state highway 315.

B. The proposed action

The Department of State Lands (DSL) administers the Montana Strip and Underground Mine Reclamation Act (Title 50, Chapter 10, R.C.M. 1947). The Reclamation Act specifies that, "An operator may not engage in strip or underground mining (for coal or uranium) without first having obtained from the Department a permit. . ." (Section 50-1039). Strip mine permits issued after July 1, 1977 will be for five years at a time and may be renewed upon application to the Department. Until July 1, 1977, permits will be issued on a one year basis.

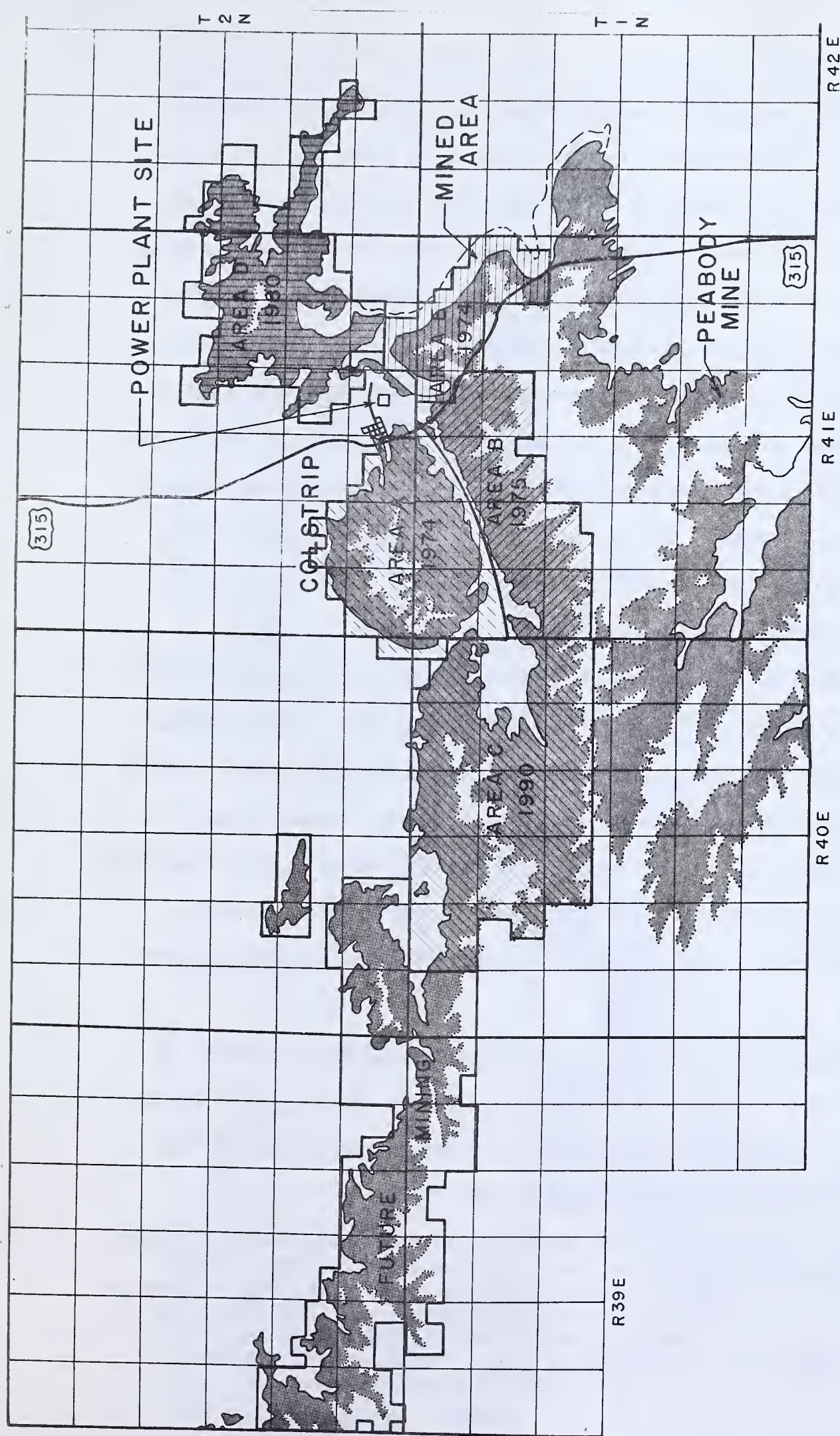
Permit amendments may also be issued, however, when permit acreages are increased, the period for which the initial permit was issued is not extended. Also, permit amendments have the same operator application and Department review requirements as do original permits.

On December 20, 1976 and December 27, 1976, Western Energy Company (WEC) submitted applications to amend the Surface Mining Permit for their Rosebud Coal mine (application nos. 00040 and 00041). With such amendments, WEC is seeking to expand mining activity in both the area A and area E portions of the Rosebud mine. Specifically, WEC wants to permit 1844 acres--656 acres in area A and 1188 acres in area E. Disturbances



STATE OF MONTANA

Figure 1: locator map
(from: Taylor, Edie and Gritzner 1974)



COLSTRIP COAL DEPOSIT-ROSEBUD SEAM

(MATSON & BLUMER 1973)

Source: Montana Department of Natural Resources and Conservation, 1974, Draft EIS on Colstrip Electric Generating Units 3 and 4, 500 kilovolt Transmission Lines and Associated Facilities, Helena, Montana, Volume 3A, p. 258.

~ ~ ~ ~ ~ - Limit of Rosebud

..... - 150 Ft. Overburden Limit

Figure 2

include: strip mining and spoiling, roads, and other associated mine disturbances. The topography in mine areas A and E are shown in figure 3.

The Montana Environmental Policy Act (MEPA) requires that Environmental Impact Statements be prepared on "proposals for projects, programs, legislation, and other major actions of state government significantly affecting the quality of the human environment" (Section 69-6504, R.C.M 1947). Pursuant to MEPA, the Department determined that permitting of WECO's proposed mine expansions in Areas A and E are major and significant and hence require that draft Environmental Impact Statements be prepared on the proposed actions. For the sake of efficiency, one draft EIS is being prepared for both proposed actions.

C. History of the Rosebud Mine

The Rosebud Mine was operated from 1924-1958 by the Northern Pacific Railroad as a source of fuel for its steam locomotives. In thirty-four years of mining at Colstrip, Northern Pacific produced forty-four million tons of coal (written communication, Michael Grende, Western Energy Company, February 18, 1976). Spoils from the Burlington Northern operation were left unreclaimed until 1971 when the railroad began a voluntary reclamation program. Most of these old spoils are now in some stage of reclamation.

The Montana Power Company purchased the Rosebud Mine in 1959. In testimony before the Board of Natural Resources in January, 1976, Warren P. Schmechel, President of WECO stated (written communication, Michael Grende, Western Energy Company, February 18, 1976):

"Montana Power acquired from Northern Pacific mining leases covering approximately five million tons of proven coal reserves, certain large mining machinery, the townsite and accompanying town properties at Colstrip. In 1966, Western Energy Company was formed as a subsidiary of Montana Power to manage the Colstrip properties and development. Additional mining leases, machinery and land have been subsequently acquired by Western Energy Company.

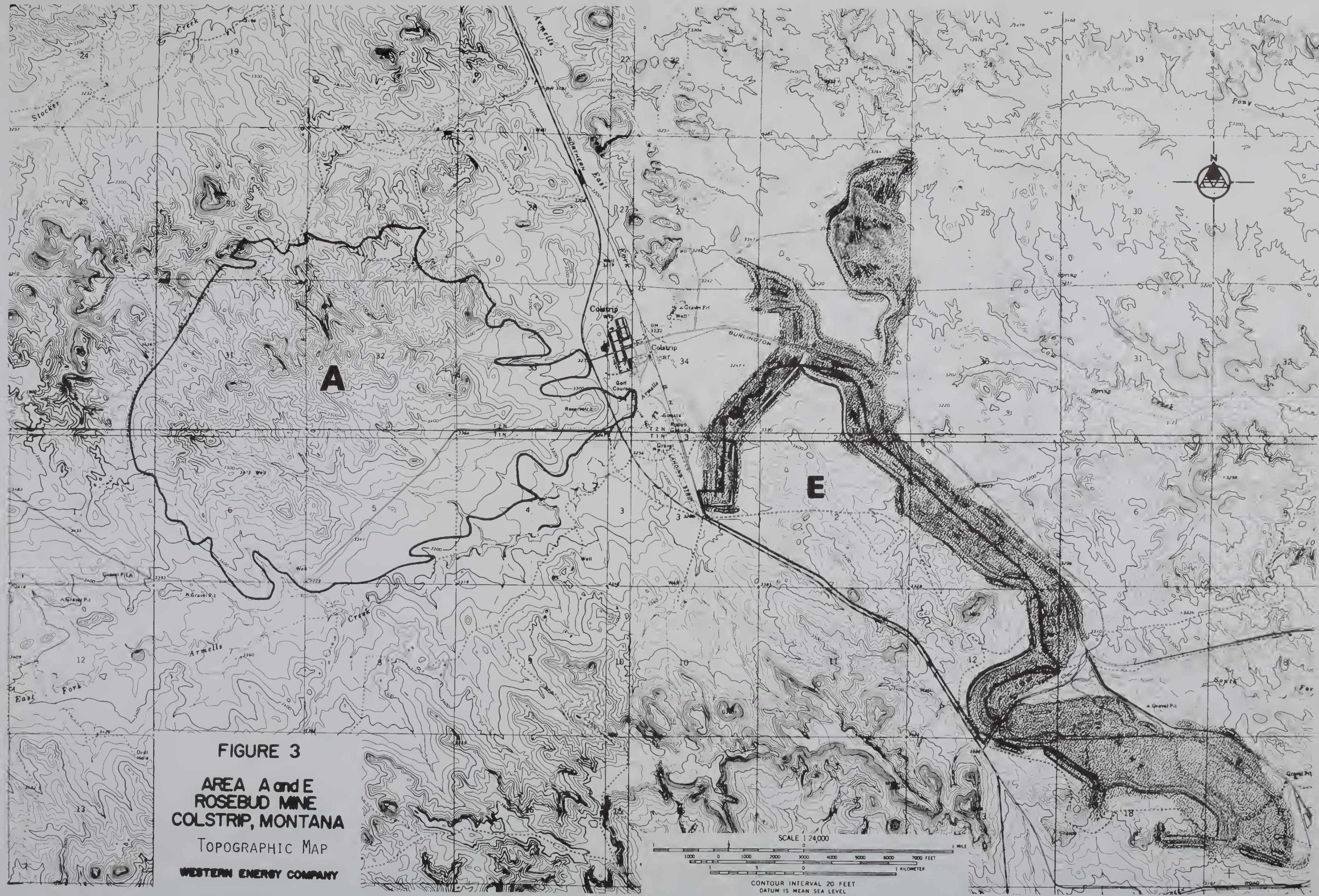


FIGURE 3
AREA A and E
ROSEBUD MINE
COLSTRIP, MONTANA
TOPOGRAPHIC MAP
WESTERN ENERGY COMPANY

SCALE 1:24,000
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

In 1968, Western Energy reopened the Rosebud Mine at Colstrip. Coal was produced initially for the Montana Power Company's Corette Steam Electric Generating Plant at Billings, commencing in July, 1968. Thereafter, Western Energy Company entered into contracts for the sale of coal to other utility and industrial customers in the Midwest."

Recent coal production at the Rosebud Mine has been as follows:

1968 -	150,000 tons
1969 -	521,000 tons
1970 -	1,658,000 tons
1971 -	5,161,000 tons
1972 -	5,501,000 tons
1973 -	4,254,000 tons
1974 -	3,212,000 tons
1975 -	6,400,000 tons
1976 -	9,324,007 tons

Projected production for 1977 is 8,460,000 tons; for 1978, 9,660,000 tons; and for 1979, 11,070,000 tons

Currently WECO is mining in areas A, B and E. Pit 6 has been mined and is being reclaimed. WECO has received eleven permits or permit amendments since the company came under the jurisdiction of the Montana Strip and Underground Mine Reclamation Act in 1973 (table 1). The company's most recent permit was an amendment to expand mining in Area E and was issued by DSL on October 20, 1976. For the entire Rosebud Mine, WECO currently has approximately 3818 acres under permit.

Figure 4 shows the surface ownership map for areas within and adjacent to areas A and E. Corresponding mineral ownership is the Burlington Northern Railroad for odd-numbered sections, and the U.S. Government for even-numbered sections.

D. Mining plan

1. Mineable seams

Mine areas A and E are underlain by two distinct coal seams presently mineable by surface technology - the Rosebud and the McKay. WECO, however, proposes to mine only the Rosebud seam in their proposed expansions in

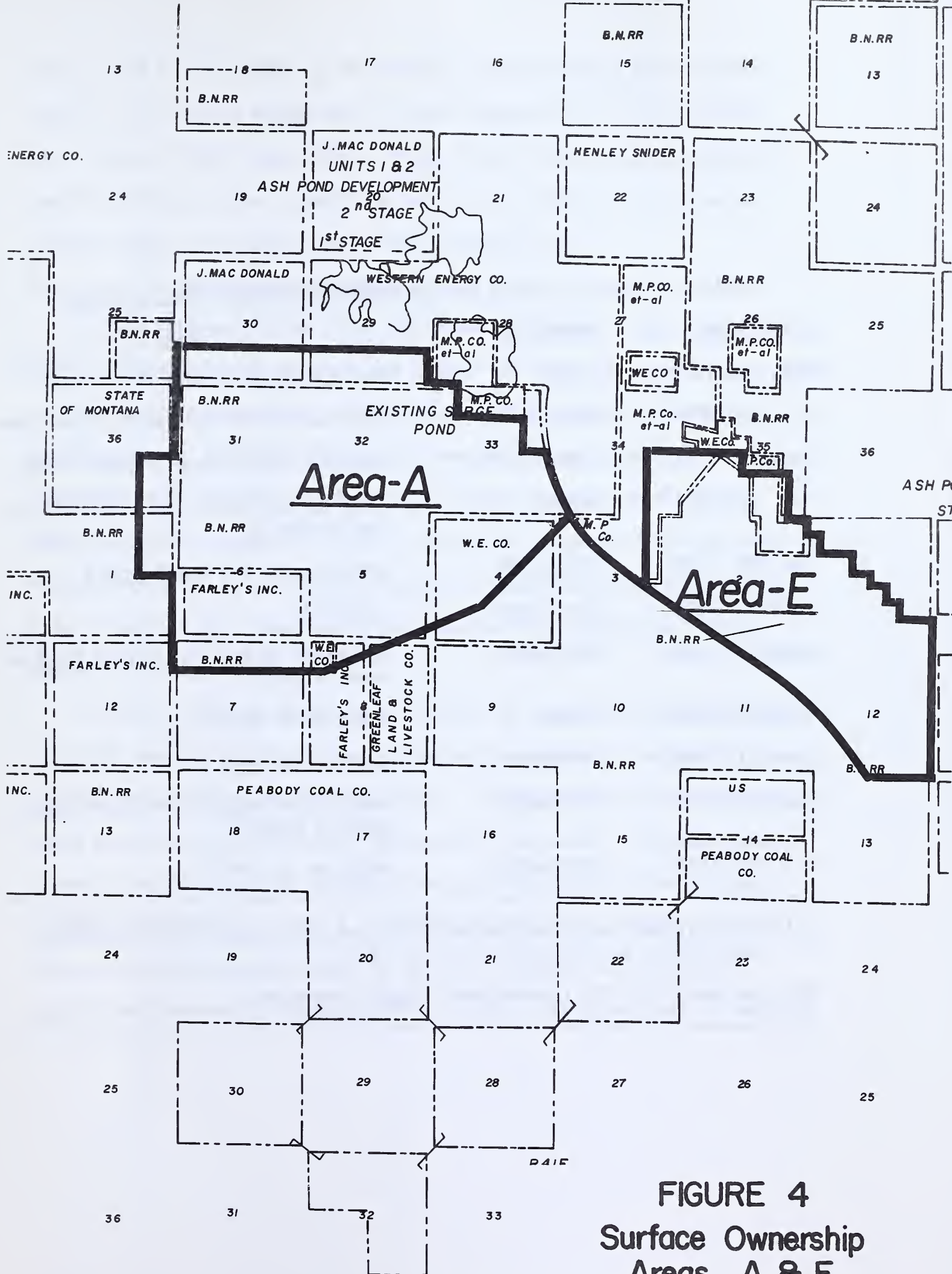


FIGURE 4
Surface Ownership
Areas A & E
ROSEBUD MINE

Table 1.-- Surface mining permits issued to Western Energy Company^(a)

<u>Date Issued</u>	<u>Permit No.</u>	<u>Area</u>
Dec. 17, 1973	73003	Pit 6, Area E, Area A Facilities ^(b)
July 5, 1974	73003-A001	Addition to Pit 6, Area E Access Road
Sept. 20, 1974	73003-A002	Colstrip Units 1 and 2 Power Plants
Dec. 21, 1974	74003	Dragline Corridor From Construction Pad to Area A
Feb. 24, 1975	74003-A001	Additions to Pit 6 and Area E
April 1, 1975	74003-A002	Area A ^(b)
August 8, 1975	74003-A003	Additions to Area E and Haul Road to Power Plant
Feb. 19, 1976	76003	Addition to Area A
June 23, 1976	76003-A001	Addition to Area A
Aug. 27, 1976	76003-A002	Area B and dragline corridor across Armells Creek ^(b)
Oct. 20, 1976	76003-A003	Addition to Area E

(a) In compliance with the Montana Strip and Underground Mine Reclamation Act, (Title 50, Chapter 10, R.C.M. 1947).

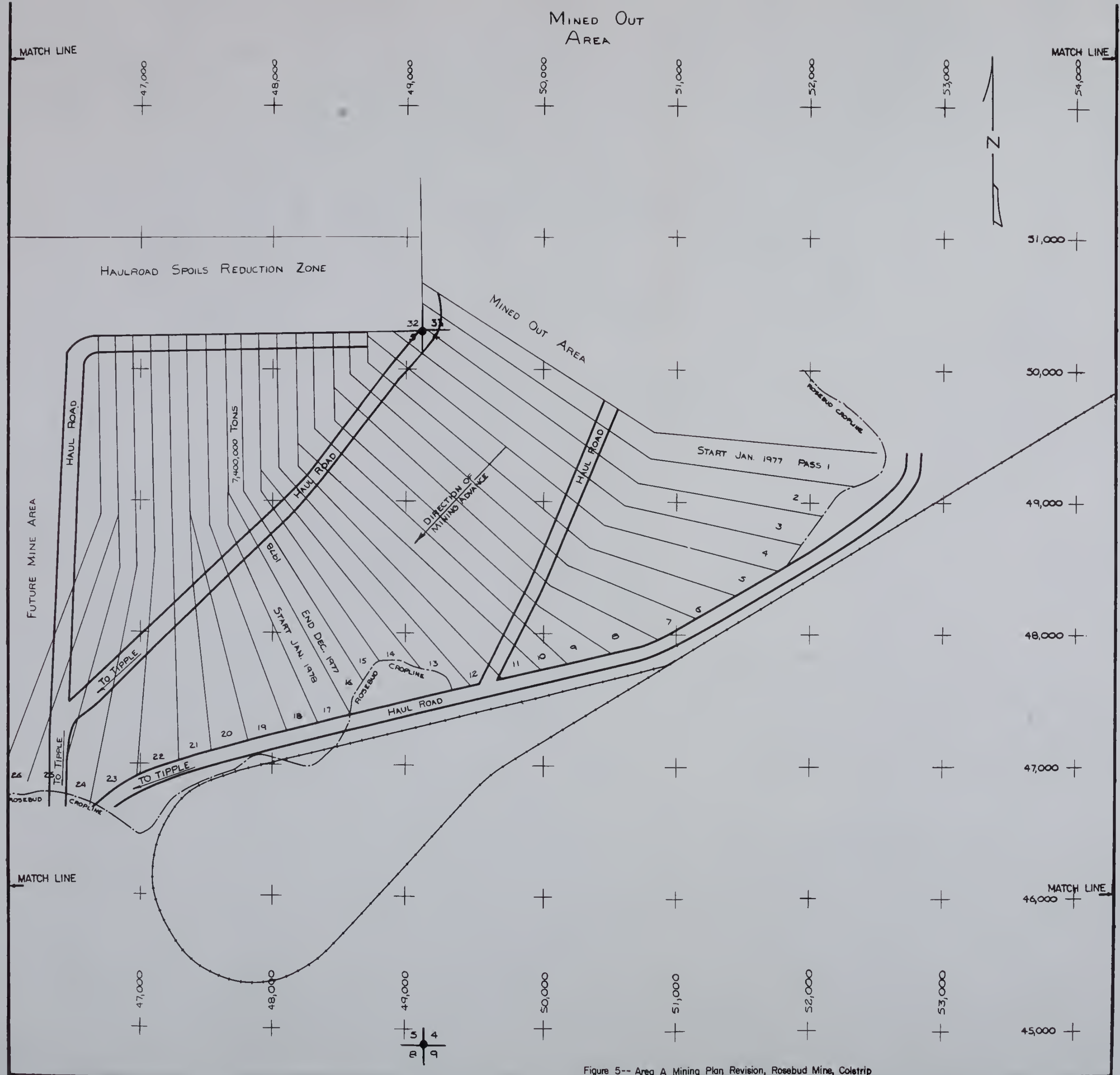
(b) Reviewed in a DSL Environmental Impact Statement.

areas A and E. The McKay is the deeper of the two seams and of poorer quality. As such, a market has not been located for it. In 1974 the Department of State Lands made a review of the situation and found that due to the high sulfur content, as well as the higher iron and sodium content there is no market demand for the McKay coal.

2. Mining plan sequence

WECO's proposed mining plans are shown in figures 5 and 6. Topsoil would be stripped with scrapers and stockpiled until ready for reapplication on the post-mined surfaces. In the event of wet conditions, crawler tractors may be necessary for topsoil removal. Once topsoil is stripped, overburden will be drilled, blasted, and then removed with a walking dragline. After exposure of coal, it would be loaded into 120 ton coal haulers and taken to coal processing and loadout facilities adjacent to areas A and E. Haul roads would be connected to existing haul road networks in the two mine areas.

Mining in areas A and E would continue to occur simultaneously and it is the purpose of WECO's proposed permit amendments to maintain current production rates for both areas. In Area A each successive cut would slowly move active mining operation to the west. The progression in Area E would be to the southeast and would occur at a slower pace than the progression in Area A. As mining progresses, areas from which the coal has been removed would be refilled, graded, recovered with topsoil and reseeded. The post-mining use for both expansions is grazing.



II. Description of the existing environment

A. Physical Environment

1. Topography

WEC's Rosebud Mine is in the unglaciated Missouri Plateau part of the Great Plains Province as described by Fenneman (1931) and in the Broken Lands of the Upper Missouri Basin as described by Hammond (1965). The topography of the region is characterized by narrow ridges, isolated knolls and buttes, gently sloping hillsides, generally narrow flood plains, and wide, shallow valleys. Elevations range from about 2,500 feet above mean sea level (MSL) on the Yellowstone River 27 miles north of Colstrip to about 4,800 feet in the Little Wolf Mountains, 12 miles west of Colstrip. Topography in areas A and E consists of many isolated low knolls and buttes with gentle to moderate sloping hillsides.

The higher buttes and knolls are capped by sandstone and/or clinker. Area A ranges between 3,240 to about 3,660 feet above MSL (fig. 3) and a main ridge containing isolated knolls trends southwest-northwest through the area. Mining in the eastern portion of Area A has somewhat altered the original topography by creating a smooth, gently-rolling terrain. East Fork Armells Creek borders Area A on the south and separates Areas A from Area E (fig. 3).

Elevation in Area E is highest in the southeast portion where an isolated butte reaches 3,575 feet above MSL. From here the terrain gradually drops to the north reaching about 3,220 feet. Area E is bordered on its northwest, northeast, and southeast sides by a small area of mine spoil material that was placed there prior to the enactment of Montana's Strip and Underground Mine Reclamation Act (fig. 3). Such spoils occur as ridges which rise up to 100 feet and extend about 1,000 feet across. A state highway route, FAS 315, borders Area E on the southwest.

Gentle to moderately-sloped areas within Areas A and E are covered with native grasses, and most hills, knolls, and steep facing north slopes have stands of pine. In spoils areas, placed prior to enactment of the Montana Strip Mine and Reclamation Act (orphan spoils), the surface has not been regraded or reclaimed and, generally, only a sparse cover of native vegetation (mainly grasses) exists.

2. Climate

a. General

Climatic data presented herein were collected primarily by the U.S. Department of Commerce at the cooperative National Weather Service Station in Colstrip. Supplementary data from other locations in the vicinity are also included where needed to clarify the climatological description; these locations are identified within the text.

The Colstrip area has a semi-arid climate that is typical of much of the Northern Great Plains (Ecological Consulting Service, 1974). Winter precipitation, which occurs mostly as snow, is light, with just over a 1/2 inch per month falling from November through February. Summer precipitation occurs primarily as light showers. In late spring, and in late September and October, occasional rains of several hours duration occur.

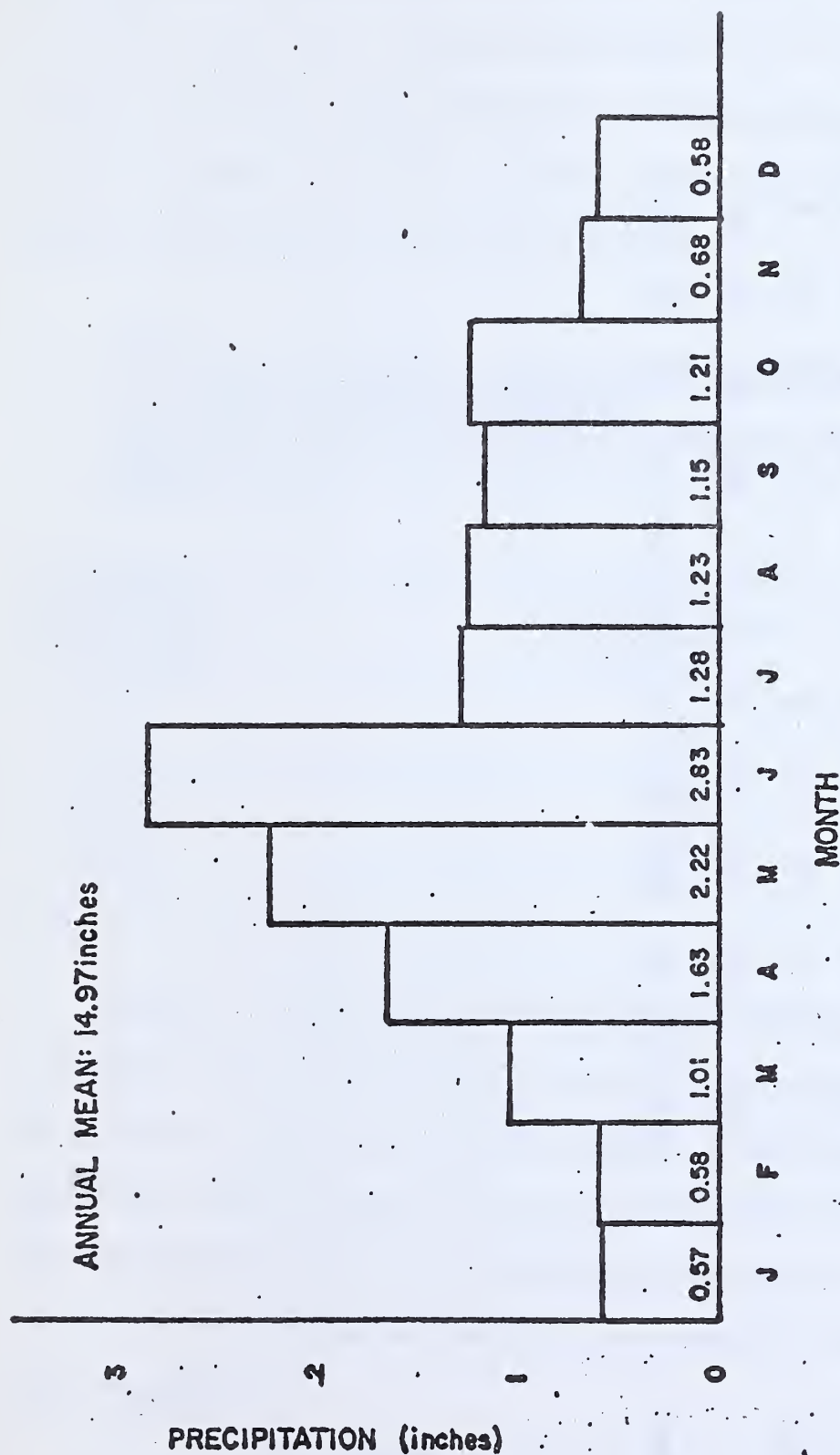
Summers at Colstrip are characterized by warm days and cool nights. Temperatures of 90 degrees or more are reached on about 40 days a year and can occur any time from May through October, although most such days occur in July and August.

Colstrip winters are cold with minimum temperatures generally being 32 degrees or colder at night and maximum daytime temperatures being in the mid-thirties and sometimes warmer. An occasional cold spell will generate sub-zero temperatures, but these spells seldom last more than a few days.

Spring and fall are characterized by wide day-to-day fluctuations in temperature, particularly in the late fall and the early spring.

b. Precipitation

Colstrip receives an average annual precipitation of about 15.0 inches, 45 percent of which occurs from May through July as scattered thundershowers (fig. 7). May and June have the two highest monthly precipitation averages (2.22 and 2.83 inches, respectively) and the highest mean number of days during which precipitation totals of 0.10 inch or more occur (table 2).



^a BASED ON RECORDS FROM 32-34 YEARS PRIOR TO AND INCLUDING 1960

Figure 7.--Mean monthly total precipitation, Colstrip, Montana^a
(from U.S. Dept. of Commerce, 1965)^a

Table 2.-- Mean number of days with precipitation ≥ 0.10 or ≥ 0.50 inch
Colstrip, Montana
(from U.S. Dept. of Commerce, 1965)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Yr</u>
>0.10 Inch	1	2	2	5	6	6	2	4	2	2	3	2	37
(Years of Record)	7	7	7	7	7	7	7	7	7	7	7	7	
>0.50	0	0	<½	1	1	2	1	1	<½	<½	<½	<½	6
(Years of Record)	10	10	10	10	10	10	10	10	10	9	10	10	

Twenty-four hour precipitation totals of 0.50 inch or more are typically more numerous in June than in any other month. In the fall thundershower activity occurs less frequently and general rain and snow systems of Pacific or Arctic origin become the dominant storm feature (Ecological Consulting Service, 1976^a). Table 3 gives the estimated return periods for various precipitation events at Colstrip.

Table 3.-- Estimated return period for specified precipitation events for the Colstrip area
(Data from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1973 as reported in Munshower and Deput, 1976).

<u>6-Hour Precipitation (inches)</u>	<u>24-Hour Precipitation (inches)</u>	<u>Return Period (years)</u>
1.0	1.4	2
1.3	2.0	5
1.6	2.4	10
2.0	3.0	25
2.2	3.4	50
2.4	3.8	100

Droughts in the Northern Great Plains have been observed to occur with a frequency that appears to be in 11 and 23 year cycles (Toole, 1976). Although the cause of the cyclical nature of the droughts is not clearly understood, they do tend to occur quite regularly and may be severe. A quantitative discussion of precipitation patterns for the Colstrip area is contained in an unpublished manuscript prepared by John McBride (1976) (see Appendix A).

c. Snowfall

The average annual snowfall at Colstrip is 45.8 inches (see Appendix A). The highest monthly average is 9.3 inches in March, followed by 6.8 inches each in December and February (U.S. Department of Commerce, date

unknown). Heavy snowfall is uncommon; from 1946 through 1963 for example the greatest 24-hour snowfall recorded occurred in December, 1950 and was less than 10 inches.

d. Evaporation

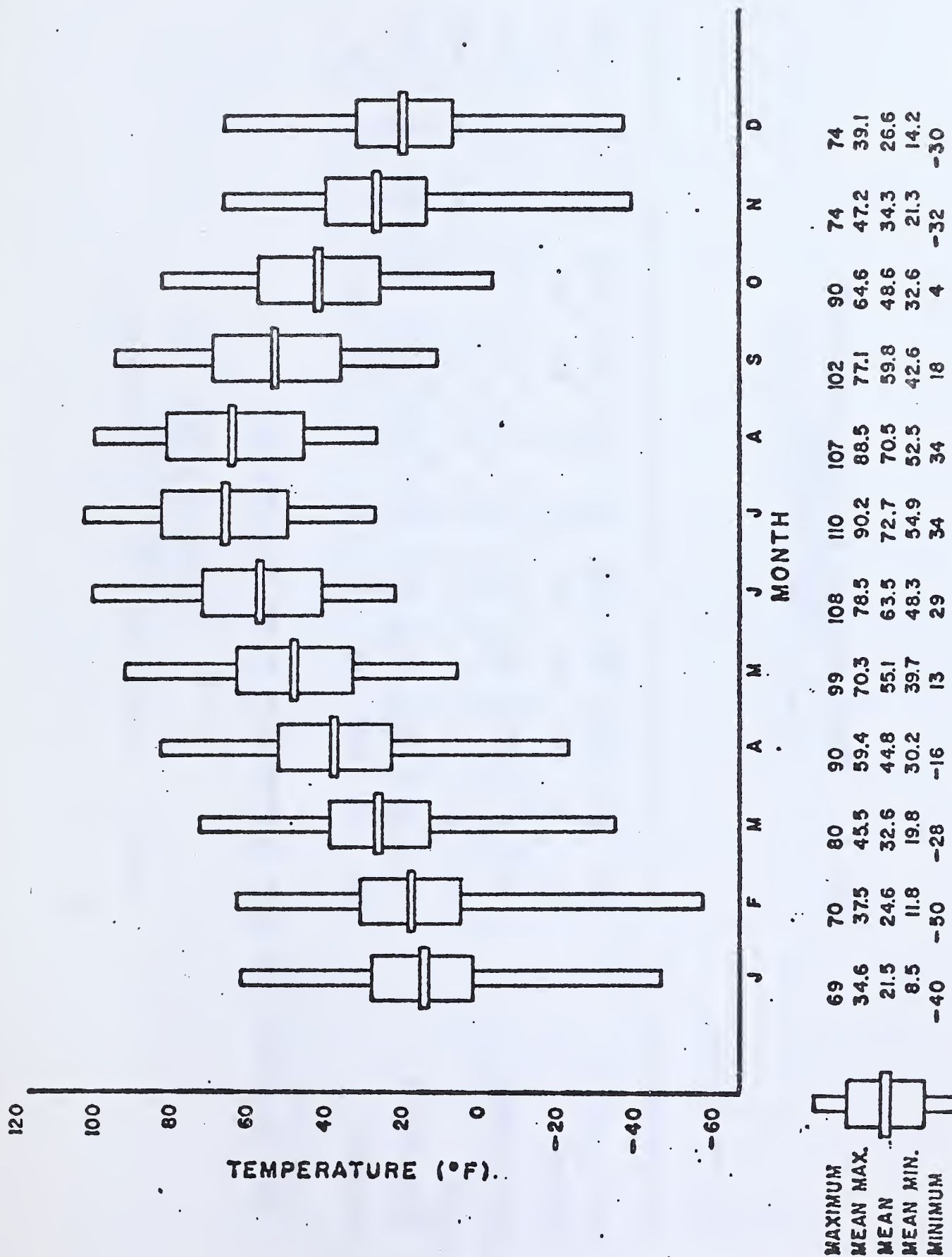
Evaporation data are not currently available for Colstrip but are available for the community of Terry, located approximately 90 miles to the northeast (Appendix A). These data, based on 5 to 10 years of records collected prior to and including 1960, indicate that an average of about 40 total inches of evaporation can be expected from May through September. Evaporation data are not obtainable from October through April because of frequent periods of below-freezing weather (U.S. Department of Commerce, 1965).

e. Temperature

Temperature data for Colstrip (fig. 8) indicate that during the 28-29 year period of record, temperatures ranged from as low as -50°F to as high as 110°F . Average daily maxima ranged from 34.6°F in January to 90.2°F in July; average daily minima ranged from 8.5°F in January to 54.9°F in July (table 4). July and August are typically the warmest months, averaging 17 and 14 days, respectively, when the temperature reaches or exceeds 90°F (table 5). The daily maximum can be expected to reach or exceed 90°F on an average of about 39 days per year. Temperatures can be expected to drop to 32°F or lower nearly every day in December, January, and February (table 5).

f. Wind

Annual and seasonal wind data for November, 1971, through November, 1972, are presented graphically on figure 9. Such data were collected from a 307 foot meteorological tower located at Colstrip. These data indicate that winds 307 feet above the ground are predominantly from the northwest. Westerly through northwesterly winds prevailed from November through July.



^a BASED ON RECORDS FROM 28-29 YEARS PRIOR TO AND INCLUDING 1960

Figure 8.--Monthly means and extremes in temperature, Colstrip, Montana^a
(from U.S. Department of Commerce, 1965)

Table 4. -- Monthly means and extreme in temperature
Colstrip, Montana^a
(From U.S. Dept. of Commerce, 1965)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
Maximum	69	70	80	90	99	108	110	107	102	90	74	74
Mean Maximum	34.6	37.5	45.5	59.4	70.3	78.5	90.2	88.5	77.1	64.6	47.2	39.1
Mean	21.5	24.6	32.6	44.8	55.1	63.5	72.7	70.5	59.8	48.6	34.3	26.6
Mean Minimum	8.5	11.8	19.8	30.2	39.7	48.3	54.9	52.5	42.6	32.6	21.3	14.2
Minimum	-40	-50	-28	-16	13	29	34	34	18	4	-32	-30

^aBased on records from 28 to 29 years prior to and including 1960

Table 5. -- Mean number of days with temperature
>90°F or ≤32°F
Colstrip, Montana
 (From U.S. Dept. of Commerce, 1965)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Yr</u>
<u>>90°F</u>	0	0	0	0	1	3	17	14	4	<½	0	0	39
Years of Record ^a	10	10	10	10	10	10	10	10	10	10	10	10	10
<u><32°F</u>	30	27	28	20	5	<½	0	0	3	15	24	29	181
Years of Record ^a	10	10	10	9	10	10	10	10	9	7	7	10	

^a1951 through 1960

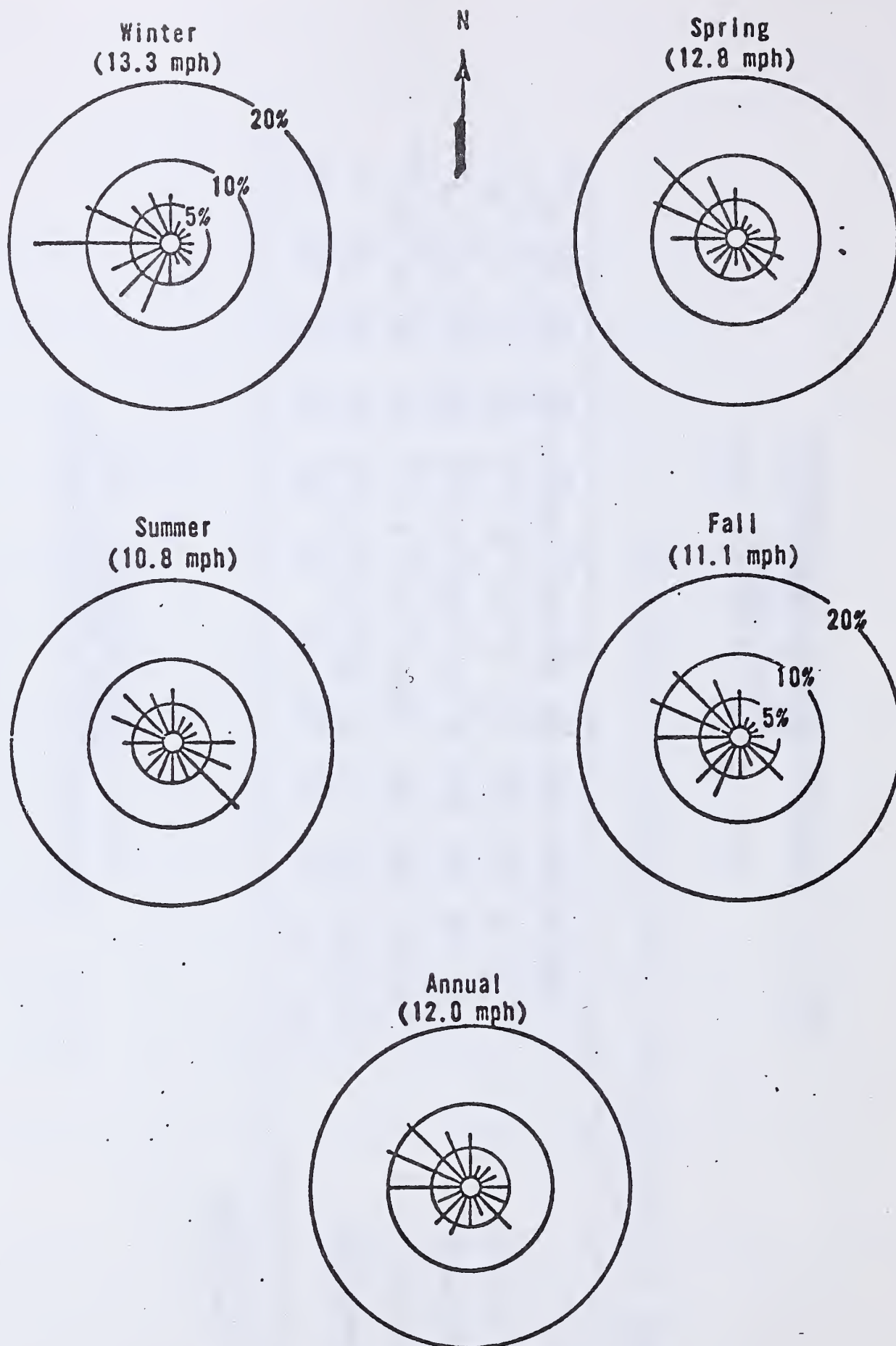


Figure 9.--Seasonal and annual wind roses at 307 ft. agl.
(modified from Montana Dept. of Natural Resources
and Conservation, 1974)^a

^a numbers indicate mean windspeed

Southeasterly winds were most prevalent during August, September, and October. Average monthly wind speeds ranged from 9.4 miles per hour in November to 15.6 miles per hour in March with an annual average of 12.0 miles per hour (Environmental Systems, 1973).

g. Severe weather

Hailstorms are typically the most common and damaging form of severe weather in Montana and occur mainly in July and August. These storms cause crop and property damage amounting to about 5 million dollars annually (Cordell, 1971).

Floods may occur in spring and early summer as a result of the melting snowpack but are more likely due to locally heavy thundershowers in late spring and summer.

From 1916-1969, 103 tornadoes were reported in Montana, mostly in open country and in the eastern third of the state. Reported damage from these storms totaled about \$1,750,000. The incidence of tornadoes is greatest in late spring and summer (Cordell, 1971).

3. Air Quality

The following discussion is limited to those air quality parameters directly affected by implementation of the proposed actions: total suspended particulates, dustfall (total settleable particulates) and concentration of gaseous pollutants. Primary data presented herein are from sampling stations in the immediate vicinity of Colstrip. These stations are operated by the Air Quality Bureau, Montana Department of Health and Environmental Sciences, the Montana Power Company, and WECO. Other supplementary data, collected by the Air Quality Bureau at separate localities, are presented to help define the general setting. For comparative purposes, the federal and Montana air quality standards are presented in Appendix A.

a. Total Suspended Particulates

Total suspended particulates (TSP) data have been collected at various locations in eastern Montana by the Air Quality Bureau. Data from Miles City, Broadus, and Hardin (table 6) show annual geometric means for 1976 of 19.0 and 15.6 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) at Miles City and Broadus, respectively, which are well below both the federal and state TSP standards. The annual geometric mean at Hardin for 1976 was $60.1 \mu\text{g}/\text{m}^3$, or just slightly higher than the federal secondary standard for TSP of $60 \mu\text{g}/\text{m}^3$.

TSP data for the Colstrip area are also presented in table 6 and indicate that the annual geometric means for 1976 at the peripheral sites of McRay and BN are well below standards. The most recent (1975) annual geometric mean for the sampling site located within the town of Colstrip exceeds both federal primary and state standards.

Table 6.-- Average total suspended particulate data for selected sites in Southeastern Montana.

(Montana Department of State Lands, 1976; Montana Department of Health and Environmental Science, 1977)

Station	Particulates (Annual geometric mean in $\mu\text{g}/\text{m}^3$) ^a	Year
Miles City ^b	19.0	1976
Broadus ^b	15.6	1976
Morton (Hardin) ^b	60.1	1976
Colstrip:		
McRay ^{b,c}	16.5	1976
BN ^{b,d}	28.3	1976
#3 ^e (In town, residential)	86.2	1975

^a $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

^b Stations maintained by Montana Air Quality Bureau

^c Station located approximately 14 miles southeast of Colstrip

^d Station located 4 miles southeast of Colstrip

^e Station maintained by Montana Power Company

Table 7 presents 24-hour samples of TSP data collected by WECO in Area B of the Rosebud mine during October and November, 1976 (for station locations see figure 10). These data indicate that Stations No. 1 and No. 3 were in excess of the 24-hour federal primary and state standards of $260 \mu\text{g}/\text{m}^3$ and $200 \mu\text{g}/\text{m}^3$, respectively, on several sampling occasions. These stations are also likely to exceed the annual geometric mean standards. Data from Stations No. 1, No. 2, and No. 3 indicate a good possibility that the federal secondary standard could be exceeded at all three of these locations. Road surfacing and watering within the mining area, mitigate to some extent some particulate problems.



Table 7.-- Twenty four hour total suspended particulates data for the Rosebud mine site
(personal communication Michael Grende, Western Energy Company)

<u>Sample Data (1976)</u>	<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>#4</u>	<u>#6</u>
10/9	88	71	590	255	72
10/15	403	203	486	106	111
10/21	99	46	348	106	207
10/27	34	16	129	22	14
11/2	132	128 ^a	531	67	52
11/8	109	112	386	85	85
11/14	502	59	261	56	31
11/20	58	48	559	42	87
11/26	<u>17</u>	<u>17</u>	<u>84</u>	<u>10</u>	<u>34</u>
2-Month Geometric Mean	98	58	317	59	59

^aTorn filter

b. Dustfall

Dustfall data collected over a 15-month period in the Colstrip area by the Montana Power Company are presented in table 8. The data indicates that dustfall in the town of Colstrip, Site No. 3, figure 11, has exceeded the Montana standard for residential areas (a 3-month average of 15 tons per square mile per month). The Montana standard for industrial areas (a 3-month average of 30 tons per square mile per month) has also been exceeded at Sites No. 3, 7, and 8; the latter two of which are located in mine areas A and B (fig. 10). At Site No. 3, (fig. 11) the standard for an industrial area has been exceeded during all collection periods except but one.

Table 9 presents dustfall analysis results for single collection periods during October and November, 1976, based on data from WECO's sampling stations (fig. 11). These data indicate it is likely that the

Table 8. -- 3-Month dustfall averages^a (tons/square mile/month)
September 30, 1974-January 31, 1976)
Colstrip, Montana
(Montana Department of Health and Environmental Science, 1976)

<u>Collection Periods</u>	<u>#2</u>	<u>#3</u>	<u>#6</u>	<u>#7</u>	<u>#8</u>	<u>#9</u>
9/30/74-12/30/74	b	43.2	b	9.1	45.5	13.4
10/30/74- 1/31/75	28.2	36.8	14.2	7.8	54.5	7.2
11/30/74- 3/ 1/75	c	c	c	c	c	c
12/31/74- 3/31/75	c	c	c	c	c	c
1/31/75- 5/ 1/75	14.8	28.0	10.7	18.4	47.4	c
3/ 1/75- 6/ 1/75	14.8	32.4	12.3	25.6	43.3	13.7
3/31/75- 7/ 1/75	16.9	33.2	15.9	47.6	24.6	20.7
5/ 1/75- 7/31/75	14.2	35.6	14.8	37.3	29.6	24.7
6/ 1/75- 8/30/75	14.2	42.4	13.0	31.6	63.9	18.7
7/ 1/75- 9/30/75	11.0	54.4	11.0	11.3	59.7	11.4
7/31/75-11/ 1/75	10.8	53.0	9.3	10.8	59.1	7.9
8/30/75-12/ 1/75	8.6	64.1	9.4	82.5	36.5	c
10/ 1/75- 1/ 3/76	21.1	58.6	8.0	88.2	40.2	13.5
11/ 1/75- 1/31/76	24.5	64.3	15.6	99.3	45.6	18.4

^a Average is based on data from 3, sequential, 1-month collection periods with valid data

^b 3-month average not determinable

^c No data

FIGURE 11

COLSTRIP, MONTANA

ENVIRONMENTAL MONITORING SITES

○ PRIMARY SITE 1,2,3

● SECONDARY SITE 4,6,7,8,9,10,11,12



scale in miles

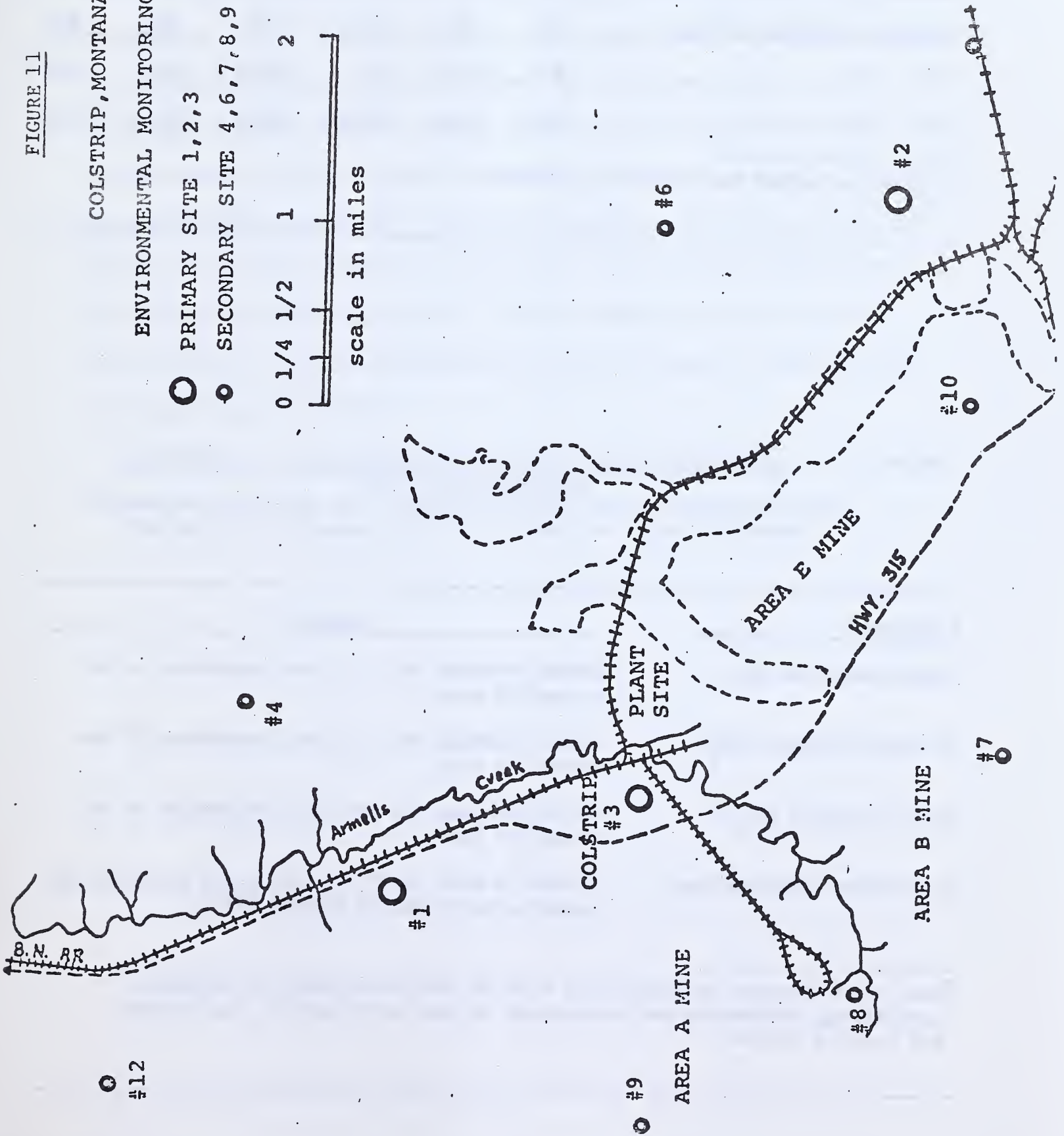


Table 9.-- Dust fall data - Colstrip, Montana - Total settleable particulates in tons/square mile
(written communication, Mike Grende, Western Energy Co.
Dec. 7, 1976 and Jan. 10, 1977)

<u>Collection Period (1976)</u>	<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>#4</u>	<u>#6</u>	<u>#7</u>
10/5 - 11/1	18.7	18.1	141.7	28.2	11.8	4.8 ^a
11/1 - 12/1	16.7	16.2	287.8	23.4	22.0	11.1

^aCollection period was 10/8/76 - 11/1/76

Table 10.-- Concentrations of gaseous pollutants - Colstrip, Montana for 1976^a
(oral communication, David Maughn, air quality engineer,
Montana Dept. of Health & Environmental Sciences)

<u>Pollutant</u>	<u>Status</u>
Carbon Monoxide (CO)	Annual average for 1976 was determined to be virtually zero.
Nitrogen Dioxide (NO ₂)	Annual average for 1976 was determined to be virtually zero.
Sulfur Dioxide (SO ₂)	Annual average for 1976 was determined to be virtually zero.
Non-methane Hydrocarbons	Federal 3-hour (6:00 to 9:00 a.m.) standard was exceeded occasionally during 1976.

^aData were recorded approximately 4 miles south-southeast of Colstrip; monitoring, collecting and processing of data conducted by the Montana Air Quality Bureau.

residential area standard has been exceeded during recent months at Station No. 1, adjacent to Colstrip. Also, dustfall is likely to have exceeded the industrial area standard during recent months at WECO's Station No. 3.

c. Other Pollutants

Data collected by the Air Quality Bureau with regard to gaseous pollutants in the vicinity of Colstrip are summarized in table 10. These pollutants are those commonly contained in vehicle emissions. The summaries indicate that the annual (1976) average concentrations of carbon monoxide (CO), nitrogen dioxide (NO₂), and sulfur dioxide (SO₂) were well below both federal and state standards. The 3-hour (6:00 to 9:00 a.m.) federal standard for non-methane hydro-carbons however was exceeded occasionally during 1976. Data accumulated to date has not been conclusive enough to allow the Air Quality Bureau to determine why such levels were so high.

4. Geology

a. Stratigraphy and structure

The geology of central Rosebud County has been described by Dobbin (1929), Bass (1932), Pierce (1936), and Kepferle (1954). Central Rosebud County is at the northern end of the Powder River Basin, a broad shallow syncline between the Big Horn Uplift to the west, the Black Hills Uplift to the east and the Porcupine Uplift to the north. The Powder River Basin is filled with several thousand feet of sedimentary strata from Cambrian to Holocene in age (table 11). Over most of the area the beds are essentially flat-lying with dips of about 1 degree. Precambrian granitic basement rocks underlie the region and, based on well data at Colstrip and regional geologic information, are estimated to be at a depth somewhat greater than 9,300 feet in the mine area.

The youngest sedimentary unit in the Colstrip area is the Tongue River Member of the Fort Union Formation, of Paleocene age. This unit, which comprises interbedded sandstone, siltstone, and shale has a maximum thickness in the Colstrip area of about 450 feet. A generalized stratigraphic column of the Fort Union Formation in the Colstrip area is shown on Figure 12.

b. Coal reserves

Coal beds of economic importance in southeastern Montana are confined to the Tongue River Member of the Fort Union Formation and are distributed at irregular intervals throughout the member. The coal within this unit has been extensively studied by federal, state, and private industry. Matson and Blumer (1973) estimated total strippable coal reserves at 32 billion tons on 770,000 acres in the Tongue River Member in portions of southeastern Montana.

Table 11.-- Geologic time scale
(Flawn, 1970)

<i>Era</i>	<i>Period</i>	<i>Epoch</i>
	QUATERNARY (lasted 0-1 million years)	Recent Pleistocene
<i>Cenozoic</i>	TERTIARY (lasted 62 million years)	Pliocene
		Miocene
		Oligocene
		Eocene
		Paleocene
63 million years ago	CRETACEOUS (lasted 72 million years)	
<i>Mesozoic</i>	JURASSIC (lasted 46 million years)	
	TRIASSIC (lasted 49 million years)	
230 million years ago	PERMIAN (lasted 50 million years)	
	PENNSYLVANIAN (lasted 30 million years)	
	MISSISSIPPIAN (lasted 35 million years)	
<i>Paleozoic</i>	DEVONIAN (lasted 60 million years)	
	SILURIAN (lasted 20 million years)	
	ORDOVICIAN (lasted 75 million years)	
	CAMBRIAN (lasted 100? million years)	
600? million years ago		
Late Precambrian		
Early Precambrian		

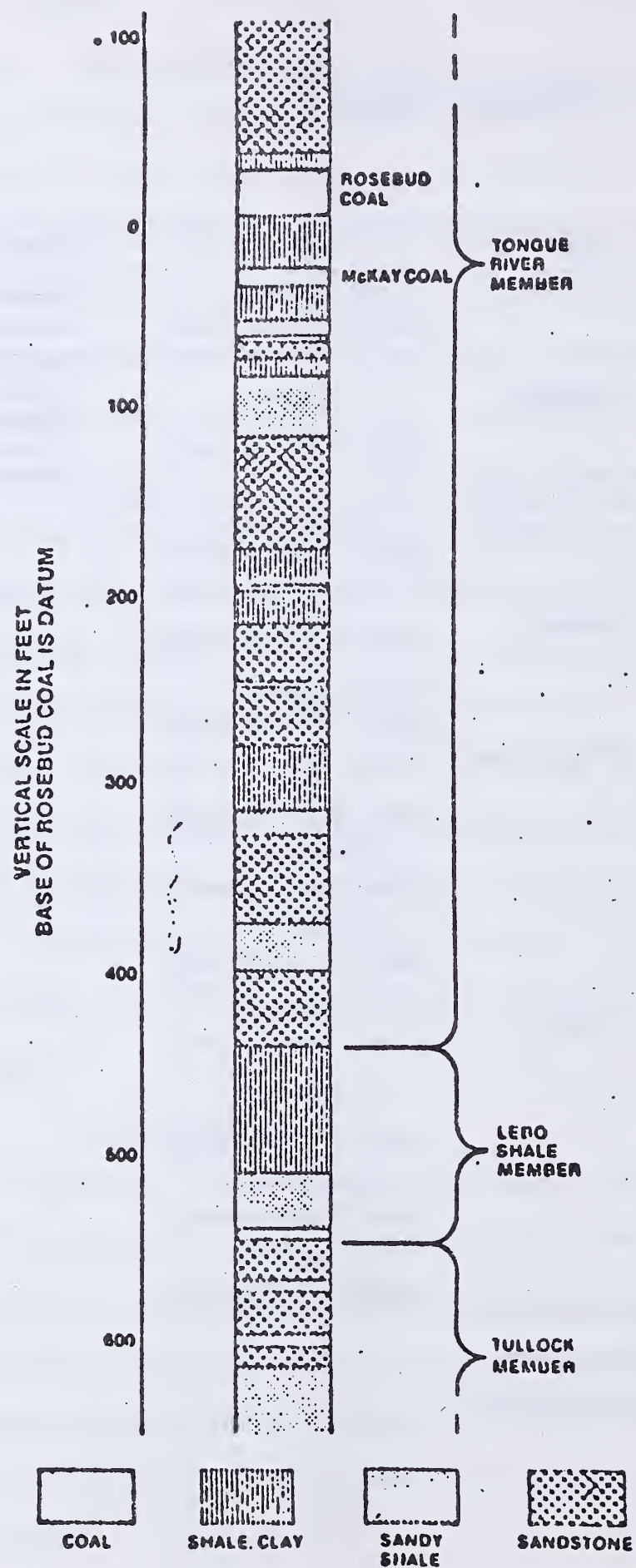


Figure 12.--Stratigraphic column of the Fort-Union formation at Colstrip, Montana

In the Colstrip area two significant coal seams occur within 200 feet of the surface - the Rosebud, and the McKay. The Rosebud seam, which is the upper of the two, has a thickness of about 1725 feet and is currently being mined at WEC's Rosebud mine at Colstrip and at Peabody's Big Sky mine immediately south of Colstrip. In Areas A and E at the Rosebud mine, the Rosebud seam averages about 24 feet in thickness and the McKay seam, averages about 8.9 feet. The two seams are separated by inner-burden averaging about 20 feet in thickness.

Approximately 1,742 tons of Rosebud and McKay coal per acre foot are found in Areas A and E. For the acreage proposed for mining in WEC's mining plan, (see Section I) this amounts to approximately 24.2 million tons on Rosebud coal in Area A and 17.2 million tons in Area E.^{1/} Correspondingly, about 10.2 million and 6.1 million tons of McKay coal occur beneath the two proposed mine level acreages. Currently the McKay seam is not being mined by WEC because they do not have a market for this lower quality coal. A comparison of Rosebud and McKay coal quality for Areas A and E is presented in Table 12.

The consolidated and unconsolidated material that overlies the Rosebud and McKay coal seams consist of interbedded shale, claystone, sandstone, siltstone, and clinker. The upper 20 to 50 feet of overburden is generally highly weathered, uncemented to poorly cemented and exhibits a yellowish brown to reddish brown color. Physical and chemical characteristics of the overburden are discussed further in section III A 5.

c. Seismicity

Since the 1860's over 1,000 earthquakes have occurred in Montana, but only a few have caused extensive damage. Most of Montana's historic earthquakes, including all the major ones, have occurred west of the plains in

^{1/} WEC proposes to mine 578 acres in Area A and 606 acres in Area E.

TABLE 12

COMPARISON OF ROSEBUD AND MCKAY COAL QUALITY
IN MINE AREAS A AND E^a

AREA A			
<u>Rosebud Coal - Average 19 Holes</u>			
	<u>Maximum</u>	<u>Average</u>	<u>Minimum</u>
Moisture Percent	28.75	26.0	23.7
Ash Percent	10.42	8.72	7.49
Volatile Percent	30.99	29.72	28.60
Fixed C Percent	37.39	35.56	33.99
BTU	8907	8569	8214
Sulphur Percent	1.21	0.81	0.42
<u>McKay Coal - Average 23 Holes</u>			
	<u>Maximum</u>	<u>Average</u>	<u>Minimum</u>
Moisture Percent	29.86	27.11	24.66
Ash Percent	9.53	6.64	5.69
Volatile Percent	29.03	27.71	24.66
Fixed C Percent	38.74	37.68	36.05
BTU	8917	8617	8381
Sulphur Percent	2.02	1.30	0.66
AREA E			
<u>Rosebud Coal - Average 10 Holes</u>			
	<u>Maximum</u>	<u>Average</u>	<u>Minimum</u>
Moisture Percent	26.5	24.35	19.7
Ash Percent	8.9	8.14	7.1
Volatile Percent	31.1	28.5	26.7
Fixed C Percent	41.3	39.01	36.9
BTU	9182	8628	8266
Sulphur Percent	1.15	0.75	0.55
<u>McKay Coal - Average 24 Holes</u>			
	<u>Maximum</u>	<u>Average</u>	<u>Minimum</u>
Moisture Percent	29.8	26.16	18.7
Ash Percent	9.9	6.87	5.2
Volatile Percent	30.3	27.23	23.9
Fixed C Percent	44.8	39.68	37.3
BTU	9382	8514	8071
Sulphur Percent	3.02	1.28	0.33

^aSource: Western Energy Company

the intermountain seismic belt (Smith and Skor, 1974). The Colstrip area lies well outside this belt and is within Zone 1 of the seismic probability map of the Uniform Building Code (International Conference of Building Materials, 1970). Only minor damage is expected in this zone as a result of ground motion resulting from earthquakes. Based on the seismic history of southeastern Montana (Coffman and von Hake, 1973) it is unlikely any major destruction will occur in the Colstrip area as a result of regional earthquakes.

5. Soils and Overburden

a. Soils

Soils on Mine Areas A and E are formed from materials ranging from valley alluvium to sandstone and shale. Thickness of topsoil layers range from very thick in alluvial valleys to shallow or absent in rock outcrop areas.

Twenty soil mapping units have been identified on Area A and 11 units on Area E (figures 13 and 14). Table 13 lists the soil mapping units for respective areas of occurrence and presents the amount of salvageable topsoil for each. Descriptions for each soil type and results of soil tests are included in Appendix B.

Of the two mine areas, Area A contains the most diverse grouping of soils. The majority of the area to be mined under the proposed mine plan is within Sections 4 and 5, T1N, R41E where the predominant soils are Remitt, McRae and Thurlow. These soils occur on alluvial fans, terraces, and footslopes and have textures that range from sandy loam to silty clay loam. They are all suited for topsoil salvage to depths over 4 feet (table 13). Soils on the northern part of Area A, primarily in Section 32, are thinner and consist predominantly of the Red Rock Outcrop Complex and the Bainville-McRae Loams. Bainville soils are suitable for salvage up to 12 inches, and McRae soils to 4½ feet or more.



Figure 13.--Soils map, Area A, Rosebud Mine, Colstrip, Montana



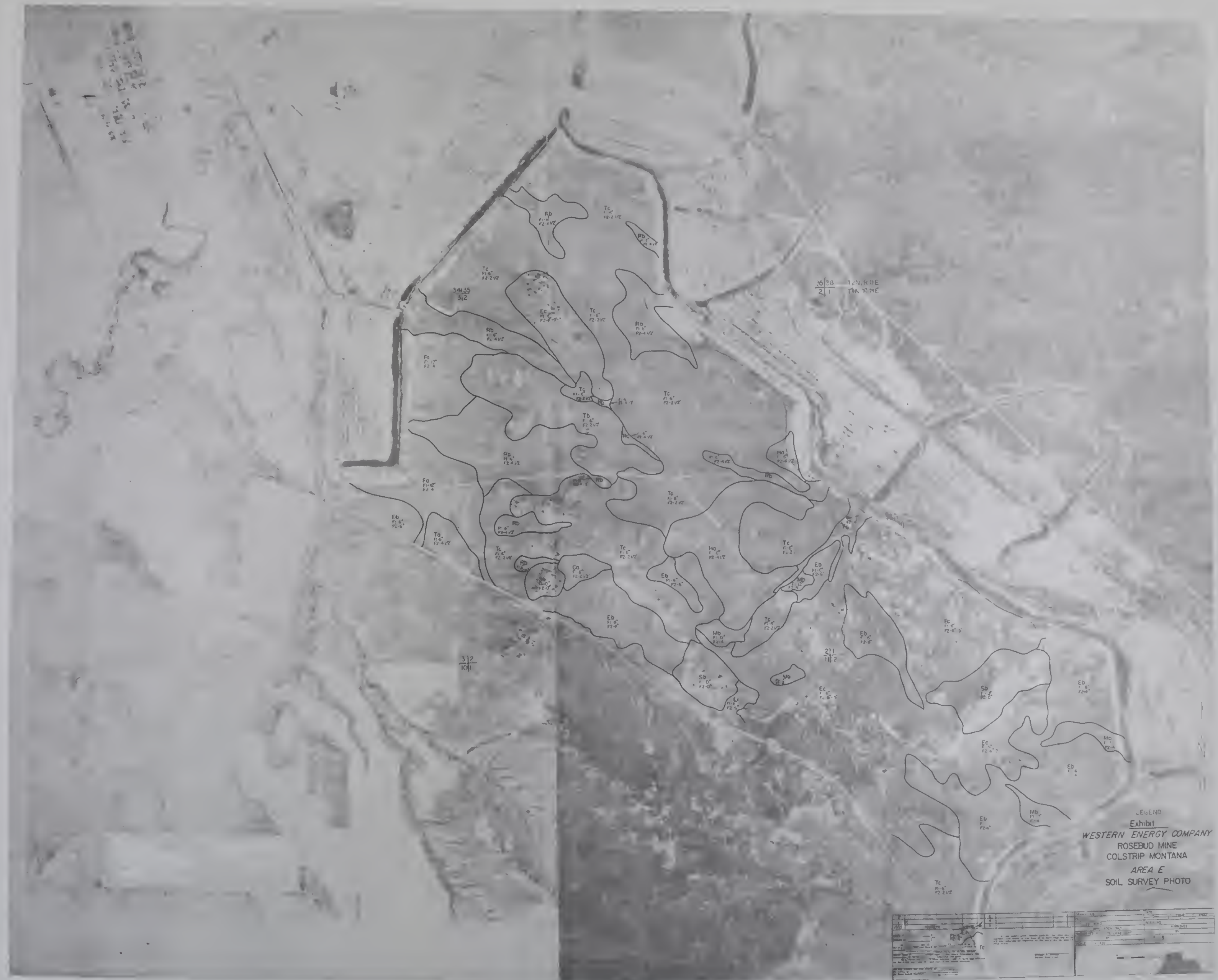


Figure 14.--Soils map, Area E, Rosebud Mine, Colstrip, Montana

Table 13.-- Legend and stripping depths for soils in Areas A and E

Symbol	Area of Occurrence		Soil Type Name	Slope	Topsoil Stripping Depths	
	A	E			A Horizons	B and C Horizons
Ca	X	X	Cushman	2-8%		
Eb	X	X	Bainville Loam	4-15%	6"	6"
Ec	X	X	Bainville-McRae Loams	15-35%	6"	6"-4½'
El	X	X	Elso Loam	15-50%	0"	1'
Fa	X	X	Fort Collins Loam	0-2%	12" ^a	4'
Ha	X	X	Heldt Silty Clay Loam	2-8%	6"	4½'
Hv	X		Heldt Silty Clay Loam	0-2%	6"	1½'
Hvg	X		Haverson Laom	0-2%	12"	4'
Ma	X		McRae Silty Clay Loam	2-8%	12" ^a	4'
Mb	X	X	McRae Loam	2-8%	12" ^a	4'
Mc	X		McRae Loam	0-2%	12" ^a	4'
Mcc	X		McRae-Elso Loams	6-15%	12" ^a	0-4'
Mt	X		McRae Loam	15-35%	12" ^a	4'
Rb	X	X	Remitt Fine Sandy Loam	2-8%	6"	4½'
Rc	X		Remitt Fine Sandy Loam			
			Red Phase	2-8%	6"	4½'
Sa	X		Shale Outcrop-Elso Complex	Very steep	0"	0'
Sb	X	X	Red Rock Outcrop Complex	Steep	0"	0'
Ta	X	X	Thurlow Clay Loam	0-2%	6"	4½'
Tb	X		Tullock Fine Sandy Loam	2-20%	6"	2½'
Tc	X	X	Tullock Fine Sandy Loam	4-15%	6"	2½'

^aIncludes upper portion of B horizon

Area E contains more soils with thin horizons and a greater proportion of rock outcrop areas than Area A. About one-sixth of the area, mainly on the west side, is covered with deep Fort Collins and Remitt soils. Tullock soils are somewhat shallower and are predominant in the northwest one-half of the area. The southeast one-half of the area contains a mixture of the Bainville-McRae Loams and the Red Rock Outcrop Complex. Salvage depths in this area range from zero in rock outcrop areas to 4½ feet in the McRae soils. Average depths of available topsoiling materials for reclamation will be lower in Area E than Area A.

b. Overburden

The overburden beneath Area A is generally of good quality and should not inhibit revegetation of topsoiled areas. Overburden test cores were sampled from 13 and 10 locations on Area A and E, respectively. Core descriptions and analyses results are contained in Appendix B. Few cores contained toxic material continuously over several depth intervals. (See Appendix A for a brief discussion on this topic). Other elements were present at toxic levels only in isolated layers.

Table 14 lists each drill hole and depth interval where toxic levels of salts or other elements were detected from core analyses taken on Mine Area A. Toxicities for individual isolated layers are not noted but are contained in Appendix B. There is considerable uncertainty regarding the levels at which individual trace element concentrations should be regarded as toxic. Toxicity levels adopted by the Montana Department of State Lands for some of the more significant and common elements are, in parts per million, as follows:

Boron	5	Lead (pH 6)	10-15	Nickel	1.0
Cadmium	1.0	Lead (pH 6)	15-20	Selenium	2
Iron	200+	Manganese	60	Zinc	40

Table 14.-- Summary of overburden analyses in Area A for potentially toxic levels (depth in feet)

<u>Core</u>	<u>Salts</u>	<u>Zinc</u>	<u>Clayey Textures</u>	<u>Nickel</u>
N47-E44	-	180-235	-	15-200
N47-E46	-	55-113	-	-
N49-E44	0-20	170-220	-	30-160
N49-E46	0-20	106-176	-	-
N49-E48	-	104-165	8-40	-
N49-E50	-	55-100	-	-
N49-E52	-	58-85	-	-
N50-E52	0-22	-	-	-
N51-E48	0-20	-	-	40-170
N52-E47	30-130	-	30-130	20-63
N53-E48	0-10	-	17-45	26-92
N54-E47	20-160	-	20-160	31-190
N55-E48	8-130	-	-	-

Overburden in Area E is more uniform and contains fewer continuous segments of toxic conditions. Of the 10 cores analyzed, 1 contained strata with significant amounts of zinc and four contained salts at high levels in the 0-30 foot zone. Table 15 is a summary of the core data, which are detailed in Appendix B.

Table 15.-- Summary of overburden analyses in Area E for potentially toxic levels (depth in feet)

<u>Core</u>	<u>Salts</u>	<u>Zinc</u>
N43-E69	-	-
N46-E66.5	0-30	-
N47-E58	0-25	-
N47-E65	0-20	-
N49-E59	-	60-82
N49-E64	-	-
N50-E62.5	0-20	-
N51-E60	-	-
N51-E61	-	-
N52-E62	-	-

6. Hydrology

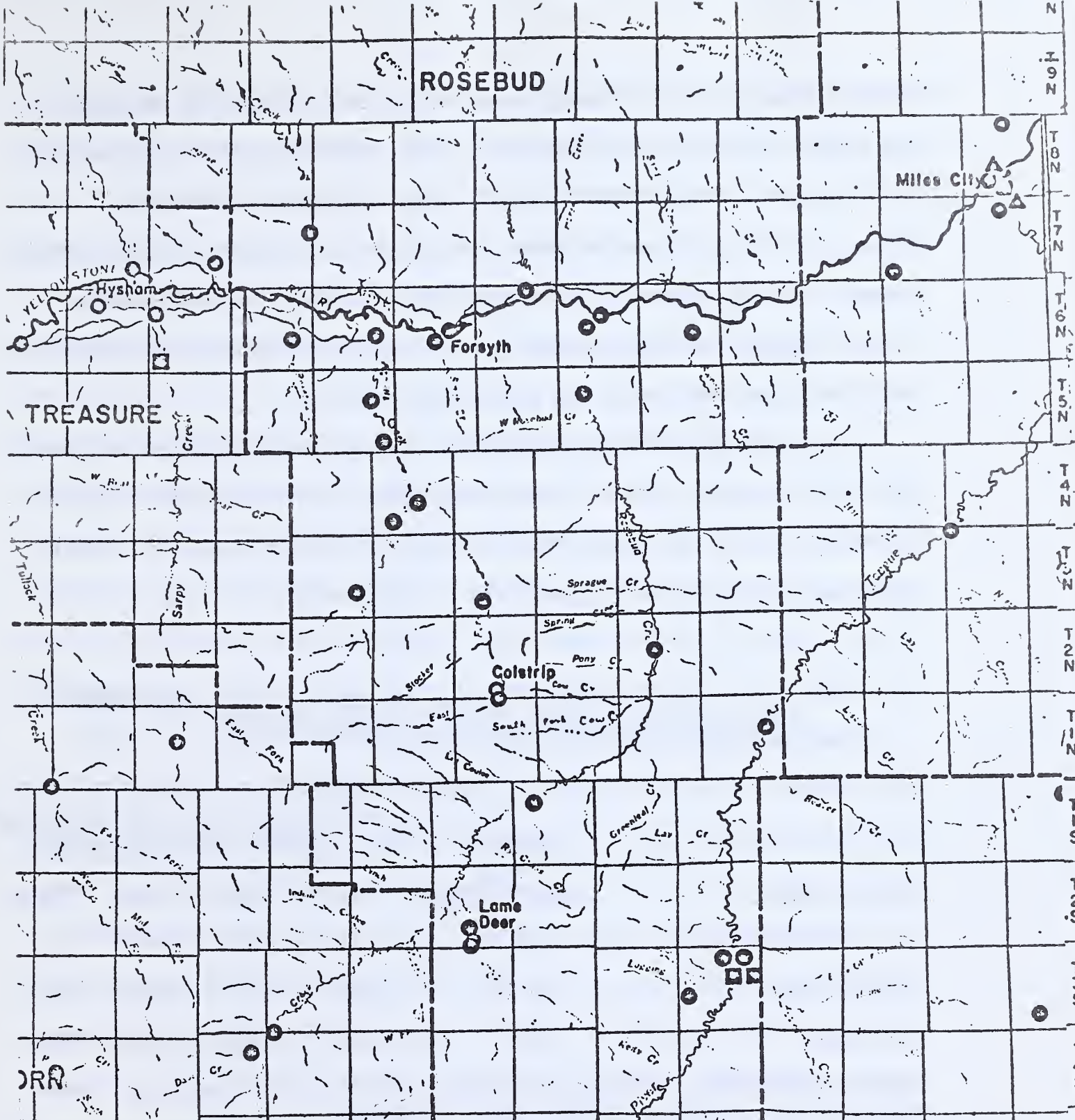
a. Surface Water

East Fork Armells Creek and tributaries of Rosebud Creek are the main surface drainage systems in the Colstrip area. Surface waters draining Mine Area A include East Fork Armells Creek, a small unnamed tributary immediately north of the Mine Area A, and several small tributaries of Stocker Creek, also a tributary to the East Fork (fig. 3). East Fork Armells Creek is ephemeral and tributary to Armells Creek which is in turn a tributary to the Yellowstone River. Armells Creek flows into the Yellowstone about 27 miles north of Colstrip (fig. 15). East Fork Armells Creek has perennial flow a few miles downstream from Colstrip due to ground water discharge to the stream. High ground water tables in parts of the Armells Creek valley north of Colstrip have caused local areas to become marshy.

Mine Area E is located in the drainages of east Fork Armells Creek and main stem and South Forks of Cow Creek. Flow in the Cow Creek drainage is ephemeral and is tributary to Rosebud Creek, a perennial creek that drains into the Yellowstone River. Surface waters from Mine Area E prior to reaching undisturbed downstream reaches of drainage, flow through drainage ditches constructed in the area of unreclaimed mine spoils that exists from former workings of the Rosebud Mine (fig. 3).

Surface flow from Mine Area A and E occurs only during periods of snowmelt and after high-intensity rainfall. Peak flows generally occur in late winter or early spring when warm temperatures produce rapid snowmelt. Specific streamflow data are not available for the streams in the vicinity of Areas A and E so estimates of flood flows cannot be directly derived.

Recent work by Van Voast and Hedges (1976) includes estimates of peak flows from 10 through 100-year recurrence intervals. Table 16 includes their estimates for streams which drain Mine Areas A and E.



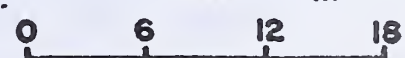
LEGEND

- Perennial Streams
- Intermittent Streams
- Perennial Lakes
- Water Quality Sampling Site
- USGS Stream Flow Gaging Site
- USGS Water Quality Sampling and Stream Flow Gaging Site

FIGURE 15
Surface Water Drainage of
Colstrip Region

Source: Montana Department of
Natural Resources and
Conservation, 1974

SCALE:
miles



R36E	R37E	R38E	R39E	R40E	R41E	R42E	R43E	R44E	R45E	R46E	R47E	R48E
------	------	------	------	------	------	------	------	------	------	------	------	------

Average annual stream discharge rates were also estimated by Van Voast and Hedges. The values indicated that less than one-tenth of one percent of the area's average annual precipitation runs off as streamflow. Almost all of the streamflow which does occur is a result of short-duration floods. The vast majority of precipitation returns to the atmosphere through evaporation and transpiration by plants. A small amount percolates into the ground and enters the ground water system.

A U.S. Geological Survey streamflow station was established on Armells Creek near Forsyth in 1974. The limited data from this station is not sufficient to estimate peak flows, however, it has been used to classify the reach of Armells Creek near Forsyth as perennial.

Table 16.-- Calculated peak-flood discharges for East Fork Armells, Stocker and Cow creeks, Rosebud County, Montana.
(Van Voast and Hedges, 1976).

<u>Drainage Name</u>	<u>Drainage area (square miles)</u>	<u>Calculated peak-flood discharge^a (cubic feet per second)</u>			
		<u>10 yr</u>	<u>25 yr</u>	<u>50 yr</u>	<u>100 yr</u>
East Fork Armells ^b	47.8	680	1090	1470	1930
Stocker Creek	25.2	460	740	1010	1330
Cow Creek	27.9	500	810	1110	1460

^aCalculation method by Johnson and Omang (1976)

^b0.1 mile upstream from Stocker Creek confluence

b. Ground Water

Ground-water investigations have been conducted in the Colstrip area in conjunction with mineral resources investigations (Renick, 1929), power plant impact analyses (Montana Department of Natural Resources and Conservation, 1974, Cordell, 1971) and strip coal mine impact analysis (Montana Department of State Lands, 1976, Van Voast and Hedges, 1974). Recent

ground-water studies have been conducted by the Montana Bureau of Mines and Geology (Van Voast and Hedges, 1975, 1976, Van Voast, 1975) and the Department of State Lands has on-going monitoring programs in the area. Definitions of terms used in this section are presented in the glossary.

Shallow aquifers which provide water in the vicinity of Areas A and E are East Fork Armells Creek alluvium (unconsolidated deposits of silt, sand, and gravel) and bedrock units of coal, silt, and sand of the Tongue River and Tullock Members of the Fort Union Formation. In the area of proposed mining, deposits of alluvium occupy the flood plains of East Fork Armells Creek. Consolidated materials of the Fort Union Formation are present beneath both Areas A and E. The only significant aquifers that occur in the mine areas are the East Fork Armells Creek alluvium and the Rosebud coal.

The alluvium has a maximum thickness of about 40 feet and consists of beds of silt and clay overlying beds of sand and gravel. The sand and gravel beds have a maximum combined thickness of about 20 feet and directly overlie consolidated Fort Union materials.

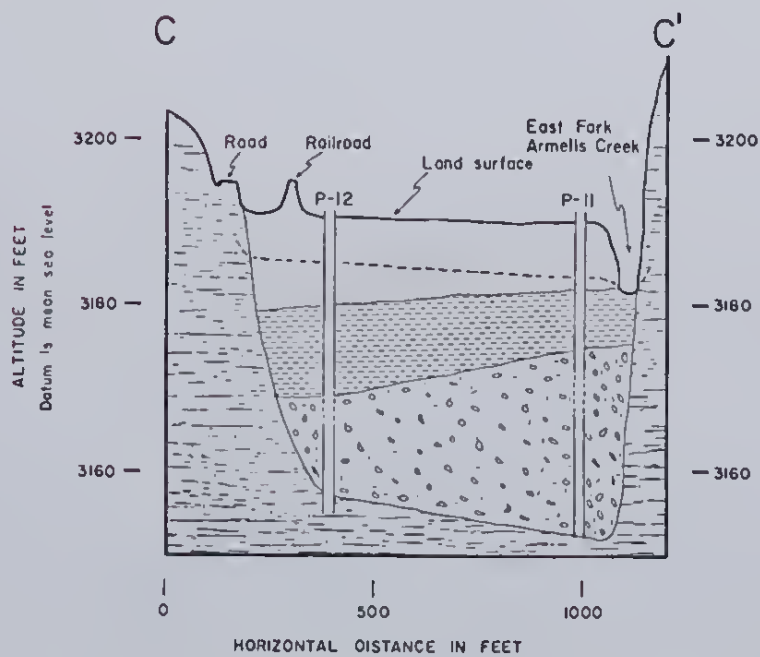
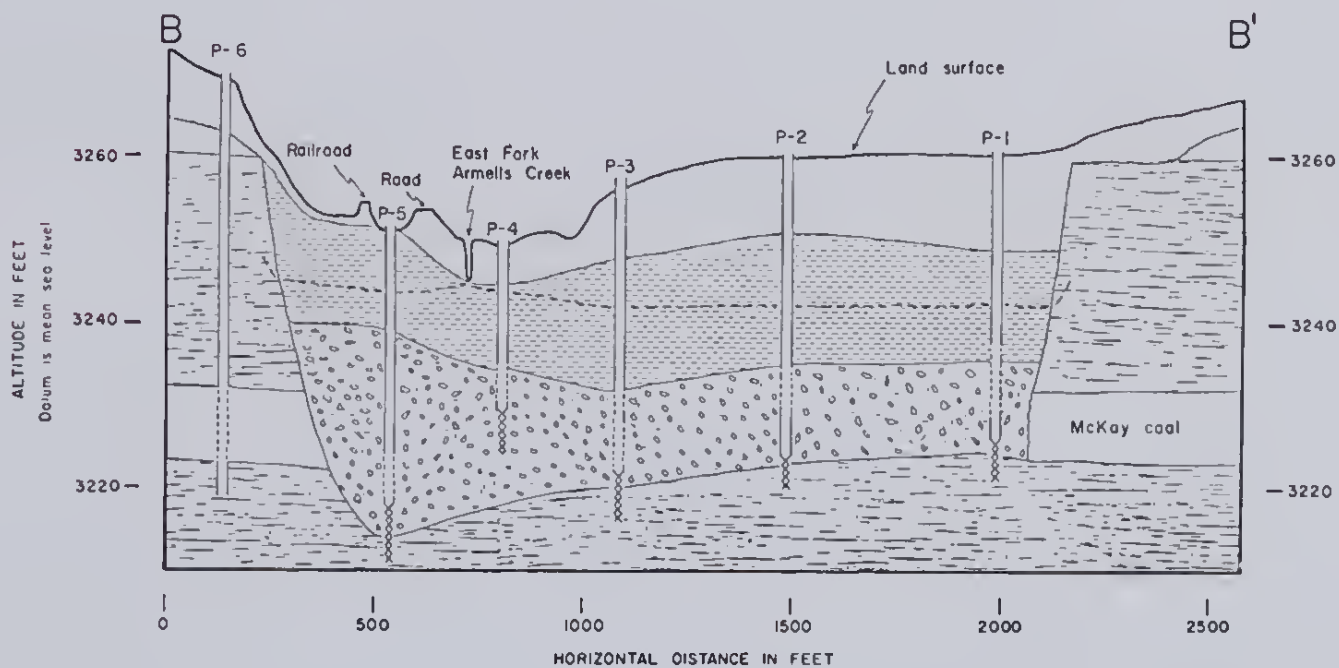
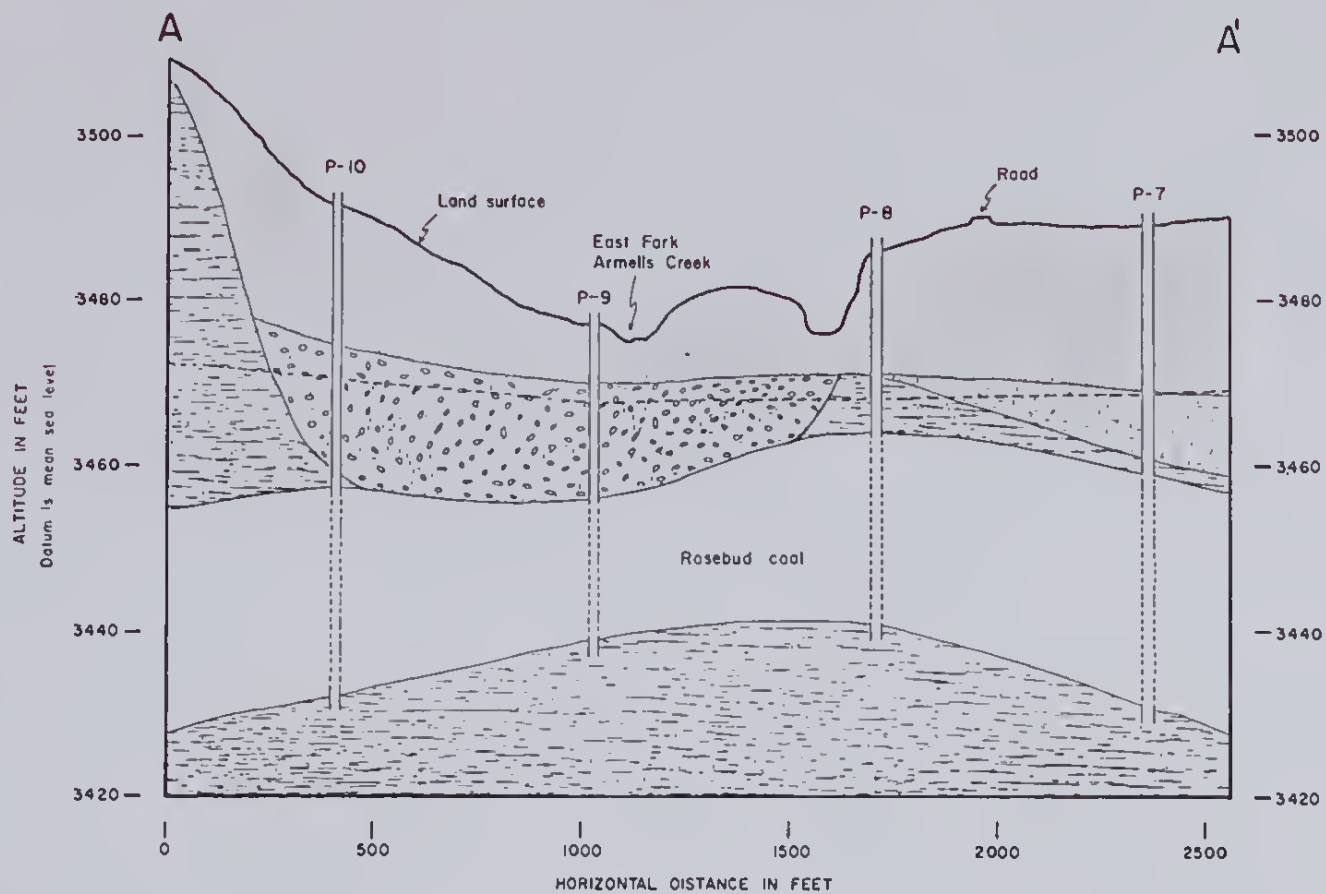
The Rosebud coal bed has a thickness of about 24 feet and it is separated from the underlying McKay coal by clay, silt, and sand beds of extremely variable local thicknesses. Total thickness of these underlying materials, termed "interburden", ranges between about 8 feet and 25 feet. The interburden thickness is not predictable at any one location and has no apparent areal trend. The thickest strata between the Rosebud and McKay coals seemingly contain the greatest thicknesses of sandstone and in these areas the sandstone beds are probably aquifers of local areal extent.

Montana Bureau of Mines and Geology has constructed observation wells across East Fork Armells Creek immediately south of Mine Area A (fig. 16). Drilling data show that at cross section B-B' the valley fill is comprised of between 30 and 40 total feet of material with 15 to 25 feet of gravel at the base, overlain by 10 to 20 feet of clay which is overlain by 5 to 15 feet of silt. Ground water is found in the gravel under slightly confined conditions.

Upstream of Colstrip in the vicinity of Area A, water levels are generally below the elevation of the channel bottom, however, downstream of Colstrip, several reaches of East Fork Armells Creek receive ground water flow year round and are a dependable stock water source. Ground water in the alluvium is recharged by discharge from coal and sandstone aquifers which outcrop and subcrop in the valley fill, and by stream flow.

The coal aquifers in the Fort Union Formation are not considered to have high primary permeability, however, they may have significant secondary permeability in the form of fractures that provide minute openings which store and transmit water. In the eastern portion of Area A the coal beds are so unfractured that they are essentially dry.

Aquifer tests have been performed by the Montana Bureau of Mines and Geology (Van Voast, 1975) on wells completed in bedrock and alluvial aquifers in the Colstrip area. Those tests indicate a large range in permeability and transmissivity of the coal beds and relatively uniform values for the gravel beds in the alluvium. Transmissivities of all aquifers in the vicinity of Colstrip range from $0.1 \text{ ft}^2/\text{day}$ to $1,900 \text{ ft}^2/\text{day}$. The highest values are for alluvial gravels along East Fork Armells Creek. A representative value of transmissivity for the Rosebud coal is approximately $10 \text{ ft}^2/\text{day}$. In general, the McKay coal would have lower transmissivity than the Rosebud coal because it is thinner.

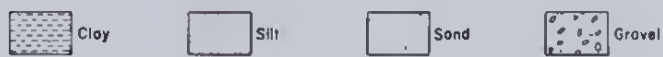


BIS - FIGURE 16
HYDROGEOLOGIC PROFILES ACROSS EAST FORK ARMELLS CREEK NEAR COLSTRIP, SOUTHEASTERN MONTANA

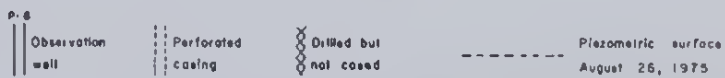
Montana Bureau of Mines and Geology December 1975

EXPLANATION

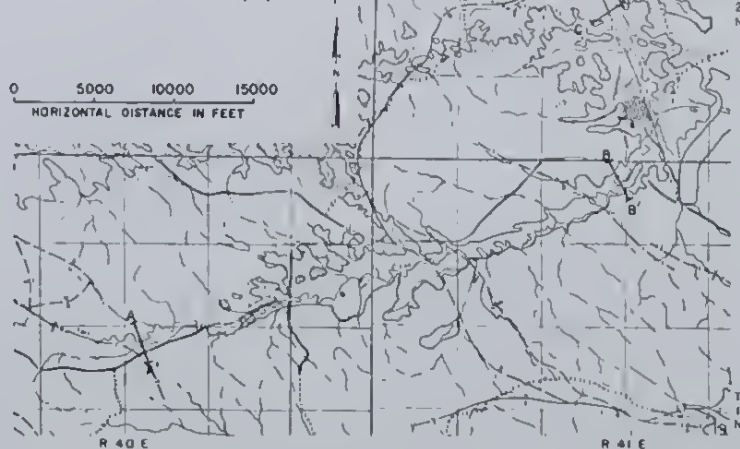
UNCONSOLIDATED MATERIALS



CONSOLIDATED MATERIALS



ORIENTATION OF PROFILES 'A', 'B', AND 'C'



The Montana Bureau of Mines and Geology also investigated the hydraulic properties of existing mine spoils. Their results indicate the range of hydraulic conductivity values for the spoils is similar to the range of values for undisturbed coal, thus it appears that the spoils transmit water at about the same rates as coal beds before mining.

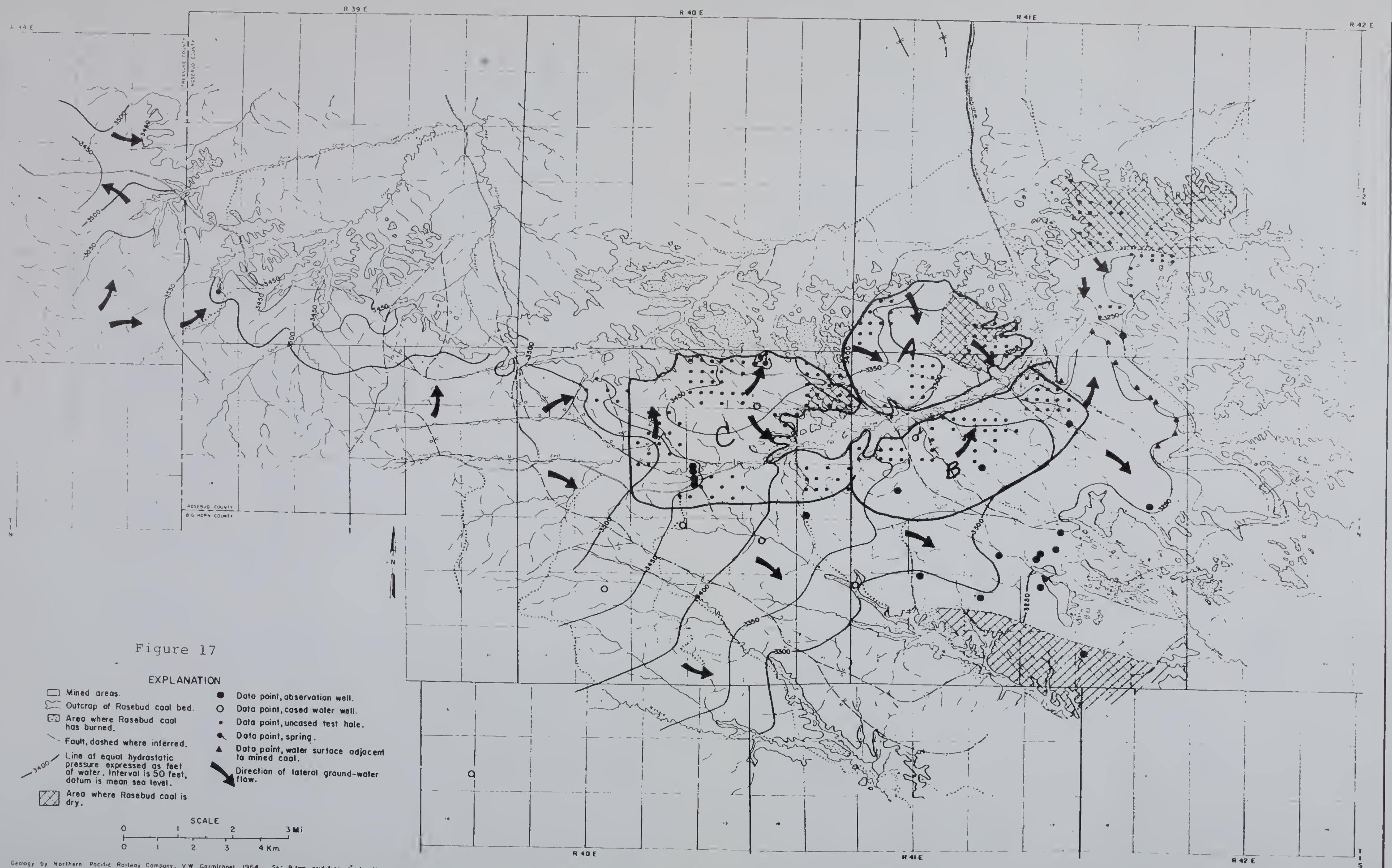
The piezometric surface and ground-water flow patterns for the Rosebud coal aquifer in the vicinity of Colstrip are shown on figure 17. The generally eastward flow direction is controlled by geologic structure, transmissivity and aquifer outcrop geometry. The Rosebud coal is recharged primarily by infiltration in the uplands west of proposed Mine Area A. Discharge from the coal is to the alluvium of East Fork Armells Creek.

Because of the great range of transmissivity of coal, estimates of ground-water flow rates are tenuous. Montana Bureau of Mines and Geology estimates of inflow from the Rosebud Coal to Areas A and E are $140 \text{ ft}^3/\text{day}$ and $50 \text{ ft}^3/\text{day}$, respectively (Van Voast and Hedges, 1976).

Ground-water flow in the alluvium of East Fork Armells Creek is parallel to the stream and occurs principally in the basal gravel zones. The average hydraulic gradient within the alluvium is about 25 feet per mile. This gradient, and an average transmissivity of about $2000 \text{ ft}^2/\text{day}$ yield a value of approximately $10,000 \text{ ft}^3/\text{day}$ as a rate of ground-water flow in the East Fork Armells Creek alluvium. It is obvious that the ground-water flow through the alluvium is significantly greater than through the coals of Area A and E.

c. Water quality

Detailed water quality studies of the Colstrip region have recently been conducted by the Montana Bureau of Mines and Geology (Van Voast and Hedges, 1976). This study included measurement of specific conductance values on numerous samples and chemical analysis of some samples.



Comparison of data to 1923 U.S. Geological Survey data (Renick, 1929) from the same area indicates that both surface and ground-water quality in the Colstrip region are highly variable.

Surface-water quality in pits, ponds, and streams in the Colstrip area is dependent upon precipitation, runoff, and groundwater discharge. Concentrations of chemical constituents in these waters are probably changing constantly. Water in East Fork Armells Creek upstream from Colstrip is less mineralized than it is downstream from the town. The upstream waters are chemically similar to many waters sampled from nearby wells and springs while the downstream waters resemble those of ponds in former Rosebud mine pits. These pits are located in the oldest part of the Rosebud mine and contain the most mineralized surface water in the area. The least mineralized water was found to occur in an active pit at the Rosebud mine; it was derived from ground water discharging directly from the Rosebud coal bed.

Water quality data for East Fork Armells Creek, (table 17), has been collected by the Montana Department of Natural Resources and Conservation, (1974), using data from Cordell (1971). In the immediate vicinity of Colstrip, the water in East Fork Armells Creek is high in calcium-magnesium-sulfate. However, the remainder of the water in the creek is high in sodium-sulfate. Waters of the stream are relatively hard and are distinctive in their high specific conductances, and therefore, in their high dissolved solids concentrations. Magnesium and sodium are dominant cations and sulfate is the dominant anion. Chloride is present in low concentrations and the bicarbonate ion is of secondary importance. Iron and manganese concentrations commonly exceed U.S. Public Health Service drinking water standards. Other trace elements including copper, zinc, chromium, cobalt, vanadium and boron have been identified in the stream.

Table 17.-- Typical chemical analysis of water in the Yellowstone River sub-basin
Armells Creek

Sampling Site	Location	Dates Sampled	Flow (cfs)	Temperature (°C)	pH (S.U.)	Specific Conductance (umhos/cm @ 25° C)	Calculated Dissolved Solids (mg/l)	Dissolved Oxygen (mg/l)	Biological Oxygen Demand (mg/l)	Fecal Coliform (counts/100 ml)	Calcium Ca (mg/l)	Magnesium Mg (mg/l)	Sodium Na (mg/l)	Potassium K (mg/l)	Total Hardness CaCu (mg/l)	Bicarbonate HCO ₃ (mg/l)	Carbonate CO ₃ (mg/l)	Alkalinity CaCO ₃ (mg/l)	Sulfate SO ₄ (mg/l)	Chloride Cl (mg/l)	Fluoride F (mg/l)	Nitrate NO ₃ (mg/l)	Phosphate PO ₄ (mg/l)	Iron Fe (mg/l)	Manganese Mn (mg/l)	Zinc Zn (mg/l)	Copper Cu (mg/l)	Cadmium Cd (mg/l)	Lead Pb (mg/l)	Arsenic As (mg/l)	Mercury Hg (mg/l)	Chromium Cr (mg/l)	Sulfate Adsorption Ratio SAR	Laboratory Turbidity (JTU)	Total Suspended Solids TSS (mg/l)	
Armells Creek 2 Fork at Colstrip	01W 41E 03B	10/24/73	0.2	8.20	8.20	3050	3679	1.9	1.9	0	285	362	272	226	226	0.45	644	0	528	2078	38	.33	0.45	0.86	0.40		0.04	0.01	0.01	0.01	0.01	0.01	0.01	2.5	1	39.0
	01W 41E 03B	1/23/74	0.05	7.21	7.21	2026	2584	1.9	1.9	0	261	220	160	1555	1555	0.78	602	0	494	1328	12.8	0.28	0.78	0.28	2.7		0.06	0.01	0.01	0.01	0.01	0.01	1.8	39	7.2	
	01W 41E 03B	4/16/74	0.2	11.8	7.81	3055	2645	10.7	2.4	0	228	281	173	1728	1728	0.04	599	0	491	1563	0.2	.30	0.04	0.03	0.41	1.5	0.03	0.01	0.001	0.001	0.001	0.001	1.8	4		
2 Fork W of Colstrip	02W 41E 28C	3/14/74	0.9	4.1	7.97	3043	4885	12.5	5.0	1	207	487	525	2520	2520	0.19	592	0	458	3048	26	.27	0.19	0.09	0.78	0.51	0.02	0.01	0.01	0.01	0.01	0.01	0.01	4.6	11	26.8
	02W 41E 28C	4/16/74	2.0	15.0	8.10	4858	4886	11.3	2.8	36	248	452	488	2460	2460	0.05	538	0	485	2904	35	.22	0.05	0.03	0.38	0.18	0.01	0.01	0.01	0.01	0.01	0.01	0.01	4.3	6	19.9
	02W 41E 28C	1/23/74	2.8	2.2	7.98	2095	1639	10.5	4.0	0	124	91	228	682	682	0.75	283	0	234	891	20	.03	0.75	0.11	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	3.8	2	3.8
2 Fork at Hwy 313	04W 40E 22CA	4/16/74	2.2	24.0	8.31	4460	4002	8.0	1.7	0	216	312	669	1412	1412	0.18	506	0	419	3286	9.0	.31	0.18	0.03	0.14	0.21	0.01	0.01	0.01	0.01	0.01	0.01	0.01	7.7	20	28.0
	04W 40E 22CA	4/14/74	1.6	15.0	8.20	3440	3026	9.30	1.5	6	192	201	888	1720	1720	0.05	610	0	333	2999	0.2	.27	0.05	0.03	0.25	0.07	0.01	0.01	0.01	0.01	0.01	0.01	9.3	17	16.8	
	04W 40E 16AB	1/23/74	3.1	2.0	7.92	3272	2769	11.0	4.4	0	167	332	468	962	962	0.05	812	0	338	1570	17.8	.44	0.05	0.03	0.65	0.13	0.01	0.01	0.01	0.01	0.01	0.01	6.6	7	12.3	
ac Highway 313	04W 40E 16AB	4/15/74	2.9	11.6	8.16	4190	3604	11.3	4.0	190	176	164	675	1116	1116	0.05	322	5	436	2049	12.0	.44	0.05	0.03	0.65	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	6.6	8	12.3
	05W 39E 16BB	1/23/74	4.5	0.0	7.96	2280	1735	11.7	6.0	0	104	68	323	340	340	0.66	413	0	261	808	13.3	.27	0.66	0.11	0.41	0.01	0.01	0.01	0.01	0.01	0.01	0.01	8.8	15	17.3	
	05W 39E 16BB	4/16/74	4.2	11.5	8.21	3210	2634	11.3	3.6	32	124	97	538	710	710	0.05	413	0	339	1444	17.0	.27	0.06	0.03	0.35	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	8.8	16	17.3
W of Foreyth	06W 39E 21AC	12/14/73	1.9	3.1	8.32	3680	701	11.3	2.1	2	120	62	138	178	178	0.05	194	0	159	292	8.2	.27	0.05	0.03	0.35	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	4.5	8	14.8
	06W 39E 21AC	1/22/74	9.2	0.0	7.80	1006	201	11.6	11.0	1120	62	58	138	178	178	0.05	312	0	420	1118	12.0	.27	0.05	0.03	0.35	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10.8	33	66.9
	06W 39E 21AC	3/1/74	2.3	4.7	8.18	2914	2301	11.8	4.7	260	63	70	525	467	467	0.05	380	0	312	1100	14.0	.27	0.05	0.03	0.35	0.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01	10.3	43	93.0
W of Foreyth	06W 39E 21AC	4/16/74	4.2	14.0	8.23	2628	2095	11.0	3.5	212	92	67	441	504	504	0.05	606	6.0	309	1500	23	.27	0.06	0.18	0.21	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	10.3	26	64.0
	06W 39E 21AC	4/17/74	4.2	13.5	8.31	3304	2796	10.9	3.6	50	99	99	606	656	656	0.05	114	0	210	204	5.5	.27	0.05	0.03	0.35	0.13	0.01	0.01	0.01	0.01	0.01	0.01	10.3	270	313	
	06W 39E 21AC	6/30/74	18.3	27.2	8.21	650	39	18.4	3.6	132	134	134	82	132	132	0.05	134	0	110	204	5.5	.27	0.05	0.03	0.35	0.13	0.01	0.01	0.01	0.01	0.01	0.01	10.3	270	313	

Source: (Modified from Cordell, 1971)

In general, the quality of water in Armells Creek may be described as poor. However, this quality improves downstream in the creek with marked reduction in the concentration of dissolved minerals. Specific conductances range from near 5,000 micromhos per cm ($\mu\text{mhos/cm}$) in the stream's headwaters to near 1,000 $\mu\text{mhos/cm}$ at its mouth during periods of above average flow runoff conditions. During periods of normal or low flow, conductivities in both the headwaters and near the mouth are significantly higher than during periods of above average runoff.

Specific-conductance values for spring and well waters provide a general indication of the chemical quality of ground water encountered in the area. Specific conductance, a measure of electrical conductivity, is an indicator of degree of mineralization of water and can be related to total dissolved solids. Near Colstrip, the dissolved-solids concentration in water, in milligrams per liter (mg/l) is approximately equal to 0.8 times the water's specific-conductance in $\mu\text{mhos/cm}$. A wide range of dissolved-solids concentrations (420 mg/l to 5,860 mg/l) have been calculated from specific conductivity data by Montana Bureau of Mines and Geology for springs and wells in the Colstrip area. The median calculated total dissolved solids value was 1,700 mg/l and 50 percent of the well and spring waters had values between 1,280 mg/l and 2,640 mg/l.

Comparisons of degree of ground-water mineralization with stratigraphic position of aquifers, position in the flow system, and areal distribution show no specific trends. With several exceptions, the Rosebud and McKay coal beds seem to provide generally the least mineralized waters of the area, and sandstone beds in the Rosebud overburden and below the McKay coal bed provide the most mineralized waters. No specific cation is predominant in water from any particular aquifer, depth, or locale; calcium, magnesium, and sodium occur in many different

proportions regardless of the total concentrations of dissolved solids. The predominant anion in most waters is sulfate. Numerous exceptions are waters containing less than 1,000 mg/l of dissolved solids; in these, bicarbonate concentrations approach or exceed those of sulfate.

The following summary of ground water quality characteristics is from the Montana Bureau of Mines and Geology (Van Voast and Hedges, 1976).

- (1) Dissolved solids concentrations in water from the East Fork Armells Creek alluvium are about 50 percent greater downstream from Colstrip than upstream.
- (2) Water in alluvium upstream from Colstrip is chemically very similar to water in the adjacent McKay coal bed.
- (3) Chemical quality of water in the Rosebud coal differs greatly at different locations.
- (4) Strong differences in chemical type and degree of mineralization occur in waters from different depths at the same location.
- (5) Spoils in the oldest part of the Rosebud mined area (northwestern end) contain water that is generally more mineralized than waters in nearby undisturbed aquifers.
- (6) Spoils in younger parts of the mined area contain waters that are chemically similar to waters from undisturbed aquifers.
- (7) Ground waters in and very close to mine spoils seemingly have cyclic temporal variations in chemical quality.

The Montana Bureau of Mines and Geology is currently investigating trace element occurrences in waters of the Colstrip area and results will be published later this year. Earlier results published by Environmental Systems (1973) of chemical analyses of waters from the oldest spoils at Colstrip and nearby undisturbed aquifers indicate that concentrations of some trace elements (lead, zinc, and nickel) were higher in water from the old spoils than in other local waters. Since then, some additional samples have been analyzed, but the results do not indicate any firm relationships. High concentrations of trace elements have not been found in waters from spoils in other parts of the Rosebud mine. It is possible that the current trace metal studies by Montana Bureau of Mines and

Geology will be able to define the existing water quality characteristics in the Colstrip area.

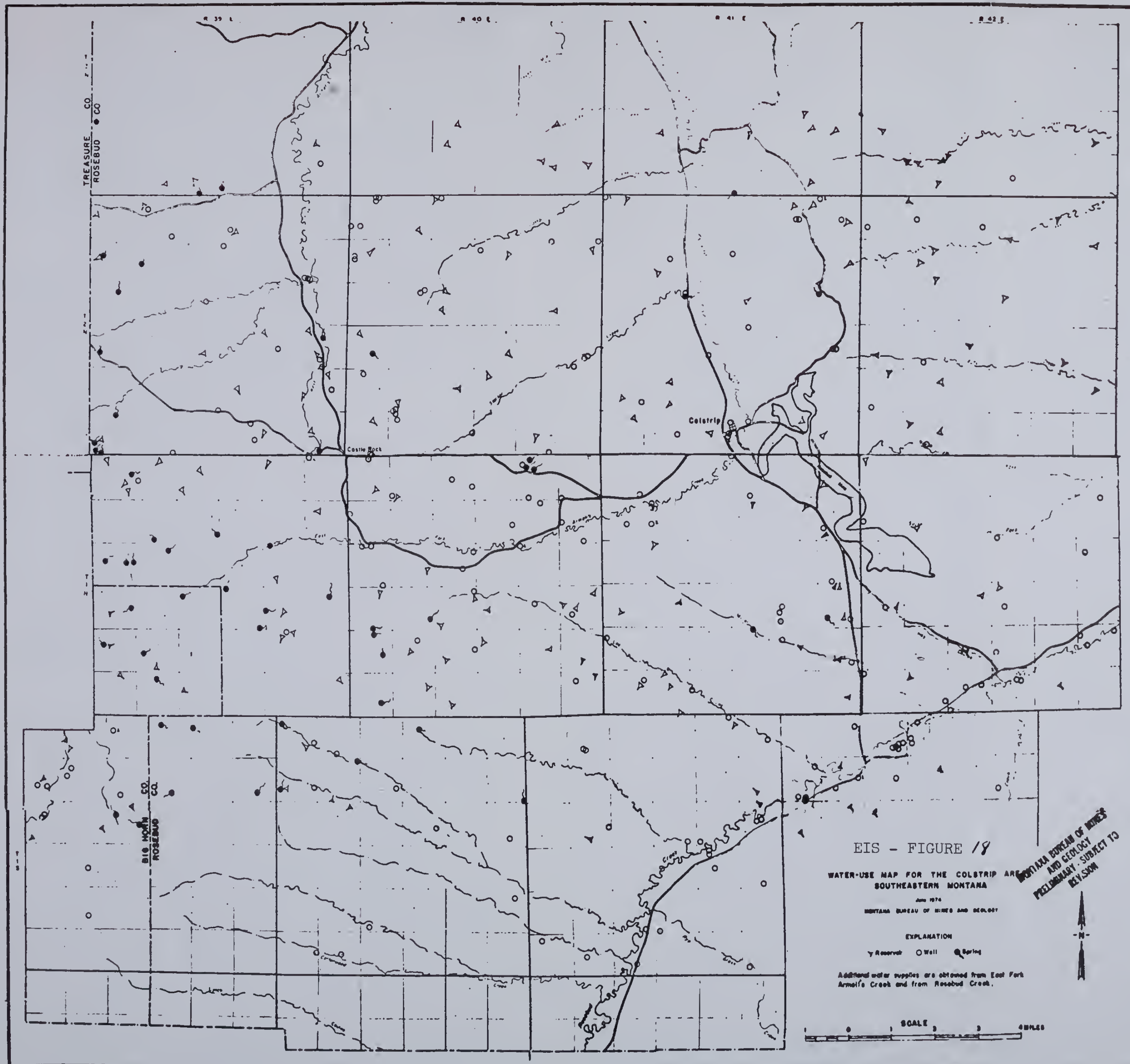
d. Water use

Outside of Colstrip, inhabitants rely upon locally impounded surface water for domestic and supplemental stock use. Inventories conducted by the U.S. Geological Survey and the Montana Bureau of Mines and Geology have documented most existing water-use locations for the area. Figure 18 shows the locations of springs, wells, and reservoirs and they are tabulated in Appendix C.

Most supplies of surface water are obtained from small reservoirs impounded by earthen dams on intermittent watercourses. The reservoirs receive runoff during the spring and early summer months and store water for use during drier periods. Although perennial reservoirs provide very dependable water supplies, their distribution is too sparse to serve all of the ranching needs of the area.

Additional livestock water is obtained from springs in the area. The discharges from many springs vary seasonally; some of them flow only during parts of each year. Geologic sources of the spring water are superficial materials at each spring locations. Most springs in the Colstrip area occur 150 feet above the Rosebud coal or below the McKay coal. Several of them discharge water from alluvium and are probably reliable sources for water supplies except during periods of extended drought.

Many wells have been drilled in the Colstrip area to obtain water for stock and rural-domestic needs. Most of the wells are less than 200 feet deep and are drilled to the shallowest sources of ground water. When pumped, few of the wells produce more than about 8 gallons per minute but most are adequate for stock and domestic needs. Significant coal beds, such as the Rosebud and McKay are utilized only where they lie within



about 200 feet below land surface. Logically, these areas nearly coincide with areas where the coal beds are economically mineable. About 80 percent of the wells provide water for livestock; the other are utilized for rural-domestic, and irrigation supplies.

Most water supplies for municipal and industrial uses within Colstrip are piped from the Yellowstone River. Montana Power Company imports the water by way of a recently constructed 26-inch diameter pipeline about 30 miles long. Most of the designed average inflow of 11.2 million gallons per day will be utilized by two coal-fired steam generation plants. About 250,000 gallons of river water per day is delivered by the pipeline to the town of Colstrip for municipal supply. Before completion of the pipeline, the municipal water supply was obtained from seven wells that drew water from sandstone aquifers 100 to 1,500 feet below the McKay coal bed and from one well completed in a limestone aquifer about 7,500 feet below land surface. These wells are presently capped and not in use.

No detailed study has been made of the use of water from Armells Creek but it is known that it is used for stock watering.

b. Biological Environment

1. Natural vegetation and agriculture

a. General Description of the Area

The vegetation of the proposed mining areas A and E consists of a variety of native range plant communities and some agricultural land (fig. 18 and 19). The native plant communities are typical of eastern Montana rangeland with ponderosa pine and associated shrubs occurring on the higher ridge areas and native grasslands occupying the lower slopes. Communities of sagebrush species and other shrubs occupy other portions of the environment. Ecological Consulting Service (1975^a) has identified 13 vegetation community types in area A excluding disturbed lands, agricultural lands or those areas affected by mining. Westinghouse (1975) has also mapped native vegetation in area A and has identified 27 different community types. For purposes of this study the Westinghouse vegetation types are equated with the community types described by Ecological Consulting Service. Ecological Consulting Service has also mapped 12 community types in the area E vicinity. In both areas A and E a disturbed grassland type, Bromus tectorum (cheatgrass) has been mapped. This type has very little native vegetation remaining. Sandstone outcrops also occur in area E and near the proposed mining area A. Roads, ponds and residential areas have also been mapped in the proposed mining area. Disturbed areas caused by mining activity have also been included. Detailed descriptions of the community types in area A and E are included in Appendix D.

The acreages of each community type within the proposed mine areas are listed in table 18. This data is based on field work from typical vegetation communities in the vicinity of Colstrip, including sites outside of the immediate permit areas. The acreages listed in table 18

Table 18- Vegetative Composition of Areas A and E

AREA A

Community Type

#	Name	Disturbance Level	%	Acres Affected
111.2	Agropyron smithii-Koeleria cristata-Carex filifolia	Mining Level Rails, Mine Buildings, and Tipple Facilities	4.0 31.5	23.13 <u>24.57</u>
				TOTAL 47.70
111.3	Stipa comata-Carex filifolia-Koeleria cristata	Mining Level Rails, Mine Buildings, and Tipple Facilities	21.3 43.3	123.11 <u>33.77</u>
				TOTAL 156.88
111.4	Calmovilfa longifolia-Andropogon spp.	Mining Level Rails, Mine Buildings, and Tipple Facilities	.6 ----	3.47 -----
				TOTAL 3.47
211	Artemisia tridentata-Koeleria cristata-Agropyron spicatum	Mining Level Rails, Mine Buildings, and Tipple Facilities	.2 ----	1.16 -----
				TOTAL 1.16
212.1	Artemisia cana-Agropyron smithii-Stipa viridula-Poa spp.	Mining Level Rails, Mine Buildings, and Tipple Facilities	14.0 10.8	80.92 <u>8.42</u>
				TOTAL 89.34
212.2	Artemisia cana-Agropyron smithii-Stipa viridula-Bromus spp.	Mining Level Rails, Mine Buildings, and Tipple Facilities	.9 2.7	5.20 <u>2.11</u>
				TOTAL 7.31
213	Rhus trilobata-Agropyron smithii-Stipa comata	Mining Level Rails, Mine Buildings, and Tipple Facilities	1.3 9.4	7.51 <u>7.33</u>
				TOTAL 14.84
214	Chrysothamnus nauseosus-Agropyron spicatum-Oryzopsis hymenoides	Mining Level Rails, Mine Buildings, and Tipple Facilities	.6 1.1	3.47 <u>.86</u>
				TOTAL 4.33
351	Pinus ponderosa-Agropyron spicatum	Mining Level Rails, Mine Buildings, and Tipple Facilities	1.5 1.1	8.67 <u>.86</u>
				TOTAL 9.53

Table 18- Vegetative Composition of Areas A and E
(CONTINUED)
AREA A

<u>Community Type</u>		Disturbance Level	%	Acres Affected
#	Name			
352	Pinus ponderosa-Juniperus scopulorum-Agropyron spicatum	Mining Level Rails, Mine Buildings, and Tipple Facilities	.3 --- ---	1.73 ---- -----
			TOTAL	1.73
651	Disturbed Grasslands	Mining Level Rails, Mine Buildings, and Tipple Facilities	--- --- ---	---- ---- -----
			TOTAL	-----
653	Residential	Mining Level Rails, Mine Buildings, and Tipple Facilities	--- --- ---	---- ---- -----
			TOTAL	-----
S	Sandstone Outcrops	Mining Level less than Rails, Mine Buildings, and Tipple Facilities	.1 --- ---	 ---- -----
530	Agriculture	Mining Level Rails, Mine Buildings, and Tipple Facilities	55.1 --- ---	318.48 ---- -----
			TOTAL	318.48
TOTAL MINING LEVEL ACRES AFFECTED				578.00
TOTAL RAILS, MINE BUILDING AND TIPPLE FACILITIES ACRES AFFECTED				78.00
COMBINED TOTAL				656.00

Table 18- Vegetative Composition of Areas A and E
(continued)

AREA E*

<u>Community Type</u>		Disturbance Level	%	Acres Affected
#	Name			
111.2	Agropyron smithii-Koeleria cristata-Carex filifolia	Mining Level	20.6	50.26
		Associated Disturbance	2.9	11.89
		Extended Highwall-Non-Coal Disturbance	7.0	11.27
		Rails, Mine Buildings, and Tipple Facilities	11.7	1.64
			TOTAL	75.06
111.3	Stipa comata-Carex filifolia-Koeleria cristata	Mining Level	26.5	64.66
		Associated Disturbance	10.8	44.28
		Extended Highwall-Non-Coal Disturbance	13.7	22.06
		Rails, Mine Buildings, and Tipple Facilities	-----	-----
			TOTAL	131.00
111.4	Calomovilfa longifolia-Andropogon spp.	Mining Level	1.1	2.68
		Associated Disturbance	3.3	13.53
		Extended Highwall-Non-Coal Disturbance	5.7	9.18
		Rails, Mine Buildings, and Tipple Facilities	-----	-----
			TOTAL	25.39
211	Artemisia tridentata-Koeleria cristata-Agropyron spicatum	Mining Level	-----	-----
		Associated Disturbance	18.9	77.49
		Extended Highwall-Non-Coal Disturbance	4.0	6.44
		Rails, Mine Buildings, and Tipple Facilities	75.9	10.62
			TOTAL	94.55

Table 18- Vegetative Composition of Areas A and E
(CONTINUED)

AREA E

Community Type

#	Name	Disturbance Level	%	Acres Affected
212.1	Artemisia cana-Agropyron smithii- Stipa viridula-Poa spp.	Mining Level	.3	.73
		Associated Disturbance	1.4	5.74
		Extended Highwall-Non-Coal Disturbance	5.4	8.69
		Rails, Mine Buildings, and Tipple Facilities	----	-----
				TOTAL 15.16
212.2	Artemisia cana-Agropyron smithii- Stipa viridula-Bromus spp.	Mining Level	18.4	44.89
		Associated Disturbance	23.0	94.30
		Extended Highwall-Non-Coal Disturbance	28.5	45.88
		Rails, Mine Buildings, and Tipple Facilities	----	-----
				TOTAL 185.07
213	Rhus trilobata-Agropyron smithii-Stipa comata	Mining Level	1.1	2.68
		Associated Disturbance	11.7	47.97
		Extended Highwall-Non-Coal Disturbance	5.5	8.86
		Rails, Mine Buildings, and Tipple Facilities	2.0	.28
				TOTAL 59.79
214	Chrysothamnus nauseosus- Agropyron spicatum-Oryzopsis hymenoides	Mining Level	.4	.98
		Associated Disturbance	4.0	16.40
		Extended Highwall-Non-Coal Disturbance	1.6	2.58
		Rails, Mine Buildings, and Tipple Facilities	9.4	1.32
				TOTAL 21.28

Table 18- Vegetative Composition of Areas A and E
(CONTINUED)

AREA E

Community Type

#	Name	Disturbance Level	%	Acres Affected
351	Pinus ponderosa-Agrophyron spicatum	Mining Level	2.6	6.34
		Associated Disturbance	13.8	56.58
		Extended Highwall-Non-Coal Disturbance	3.7	5.96
		Rails, Mine Buildings, and Tipple Facilities	1.0	<u>.14</u>
			TOTAL	69.02
352	Pinus ponderosa-Juniperus scopulorum-Agrophyron spicatum	Mining Level	----	-----
		Associated Disturbance	.7	2.87
		Extended Highwall-Non-Coal Disturbance	----	-----
		Rails, Mine Buildings, and Tipple Facilities	----	-----
			TOTAL	<u>2.87</u>
651	Disturbed Grasslands	Mining Level	2.8	6.83
		Associated Disturbance	8.3	34.03
		Extended Highwall-Non-Coal Disturbance	23.1	37.19
		Rails, Mine Buildings, and Tipple Facilities	----	-----
			TOTAL	<u>78.05</u>
653	Residential	Mining Level	.7	1.71
		Associated Disturbance	----	-----
		Extended Highwall-Non-Coal Disturbance	1.2	1.93
		Rails, Mine Buildings, and Tipple Facilities	----	-----
			TOTAL	<u>3.64</u>

Table 18- Vegetative Composition of Areas A and E
(CONTINUED)

AREA E

Community Type

#	Name	Disturbance Level	%	Acres Affected
S	Sandstone Outcrops	Mining Level	.2	.49
		Associated Disturbance	.4	1.64
		Extended Highwall-Non-Coal Disturbance	----	-----
		Rails, Mine Buildings, and Tipple Facilities	----	-----
				TOTAL 2.13
	Spoils	Mining Level	25.3	61.73
TOTAL ACRES AFFECTED		Mining Level		244
		Associated Disturbance		410
		Extended Highwall-Non-Coal Disturbance		161
		Rails, Mine Buildings, and Tipple Facilities		14
			TOTAL ACRES	829

*This data was obtained by planimetry of vegetation maps supplied with the permit application.

were derived from the vegetation maps provided by WECO including the Westinghouse data and the Ecological Consulting Service data. Cultivated lands dominate much of area A while area E is entirely native vegetation. Old strip mine spoils occur in proposed mining area E. Some of these areas, which have been graded to a level surface, occur along the north-western border of area E. Natural vegetation on these spoils has been established and is currently being intensively studied by Montana State University researchers.

b. Quantitative data describing vegetation and agriculture

The quantitative data measuring the native vegetation of areas A and E are basically of three types: 1) Coverage transects; 2) clipped transects; and 3) range site conditions. The vegetative coverage transects are run in a particular community type or an area of relatively uniform vegetation. This method follows the procedure described by Daubenmire (1959) and provides estimates of ground coverage of the species in the area. Such data have been presented by Sindelar (1972) and Ecological Consulting Service (1974, 1975^a, 1976^a).

Vegetation has also been sampled by clipping plots to determine above ground production (Appendix D; Ecological Consulting Service 1974, 1975; Sindelar 1972; Sindelar and Plantenberg 1977). A .5 or 1 square meter frame was placed along an established transect in a uniform community type and the plant species within each of the frames were clipped. After these samples were air dried and weighed to determine the total biomass produced within each frame.

A third type of quantitative vegetation data involves the determination of the "range site" equivalent for each plant community type. Range sites are based on the average precipitation of an area and the soil type of a particular community. The condition of the range site is determined

by comparing the actual percent coverage of plant species in the area with a theoretical plant species coverage of the climax vegetation of that particular range site. This method is commonly used by the Soil Conservation Service and the Bureau of Land Management for assessing the grazing capacity of large tracts of land with a minimal amount of effort. This method can be considered only semi-quantitative since actual measurements of the vegetation production are not made and only relative species composition is determined. The method is also based on the assumption that the climax vegetative community is the most productive for the area and can consequently sustain the highest grazing pressure.

The coverage data from the Daubenmire transects, the clipped plot data for areas A and E, are presented in table 19 for each of the community types occurring. Range site and A.U.M. data are presented in table 20. Confidence limits of the estimates for production are presented in Appendix D for 1974 data; the only production data for which individual plot information is available. This analysis indicates that more extensive data may be necessary if a quantitative determination of the pre-mining vegetation production is required.

A more comprehensive list of quantitative data for the graded spoils piles on the northwest portion of area E was prepared by Sindelar and Plantenberg (1977). These authors also provide an extensive plant species list of the Colstrip area (see Appendix D).

The agricultural land in the area is primarily seeded to winter wheat or alfalfa. Data from Burlington Northern indicates a normal winter wheat yeild of 25 to 40 bushels per acre in area A. Wheat production data for recent years is presented in Appendix D.

Munshower and DePuit (1976) list typical vegetation levels of essential trace elements, toxic trace elements, and other trace elements.

Table 19

Summary of Plant Biomass Production and Canopy Coverage from
Plant Communities Present on Western Energy Mining Areas A, B, and E.

Community Type	Plant Community	Forage Class	Production ² Estimate	Percent Coverage
111.1	Agropyron smithii-Bromus spp.- Poa spp.	Perennial grass Annual grass Forbs Total Biomass	1251.3 111.0 76.4 1438.7	9.1 ³ 27.0
111.2	Agropyron smithii-Koeleria cristata-Carex filifolia	Perennial grass Annual grass Forbs Shrubs Total Biomass	504.6 74.8 509.6 152.7 1241.7	39.0 43.0 2.0
111.3	Stipa comata-Carex filifolia-Koeleria cristata	Perennial grass Forbs Shrubs Lichens Total Biomass	525.6 182.9 89.8 46.7 845.0	48.0 ³ 7.0 4.0 6.0
111.4	Calamovilfa longifolia- Andropogon spp.	Perennial grass Annual grass Forbs Shrubs Total Biomass	1155.1 17.8 338.5 2.6 1514.0	67.0 ³ 29.0 2.0
211	Artemisia tridentata- Koeleria cristata- Agropyron spicatum	Perennial grass Annual grass Forbs Shrubs Total Biomass	374.2 55.7 63.2 742.3 1235.4	47.0 ³ 2.0 51.0
212.1	Artemisia cana-Agropyron smithii-Stipa viridula- Poa spp.	Perennial grass Annual grass Forbs Shrubs Total Biomass	951.3 45.7 230.8 505.4 1733.2	65.0 ³ 9.0 35.0
212.2	Artemisia cana-Agropyron smithii-Stipa viridula- Bromus spp.	Perennial grass Annual grass Forbs Shrubs Total Biomass	289.0 206.1 1145.1 432.9 2073.1	75.0 ³ 6.0 19.0

(continued on following page)

Table 19 (continued)

Community Type	Plant Community	Forage Class	Production Estimate ²	Percent Coverage
213	Rhus trilobata-Stipa comata-Agropyron smithii	Perennial grass	324.9	47.0 ³
		Annual grass	70.7	
		Forbs	169.1	18.0
		Shrubs	798.8	28.0
		Lichens	8.0	
		Total Biomass	1371.5	
214	Chrysothamnus nauseosus-Agropyron spicatum-Oryzopsis hymenoides	Perennial grass	58.3	2.0 ³
		Forbs	98.0	7.0
		Shrubs	127.2	8.0
		Total Biomass	283.5	
351 ⁴	Pinus ponderosa-Agropyron spicatum	Perennial grass	302.2	43.0 ³
		Annual grass	15.9	
		Forbs	111.2	8.0
		Shrubs	77.8	9.0
		Total Biomass	507.1	
352 ⁴	Pinus ponderosa-Juniperus scopulorum-Agropyron spicatum	Perennial grass	101.7	16.0 ³
		Forbs	36.1	15.0
		Shrubs	14.8	33.0
		Total Biomass	152.6	

¹Data from: Ecological Consulting Service. 1975. Western Energy Mining areas A, B and E. Vegetation production, condition and community typing: Proj. 107.23.A, Sept. 30, 1975, and Proj. 142-83A, Nov. 20, 1976

²Weight in pounds per acre.

³Percent is for total grass and grass-like plants.

⁴Includes tree coverage. Tree numbers are estimated at 179/acre in type 351 and 293/acre in type 352.

Table 20.-- Range Sites, Conditions, and AUM's Values
for Community Types within Areas A and E.¹

Range Site	Community Type	Condition 1975-1976	AUM's/ Acre-1976 ²	Total AUM's AREA E	Total AUM's AREA A
Overflow	111.1	55-37	.3 (.8) ³	-----	-----
	212.1	55-None	.3 (.8)	-----	-----
Silty	111.2	47-33	.2 (.6)	15.012	9.54
	111.3	32-59	.3 (.6)	39.3	47.064
	212.1	None-56	.3 (.6)	4.548	26.802
	212.2	41-62	.3 (.6)	55.521	2.193
Sandy	111.4	70-65	.3 (.6)	7.617	1.041
	213	37-27	.2 (.6)	11.958	2.968
Clayey	211	31-30	.2 (.6)	18.91	.232
Dense Clay	214	16-13	.075 (.5)	1.596	.325
Thin-Hilly	351	76-76	.35 (.5)	24.157	3.336
	352	49-40	.15 (.5)	.4305	.260
			TOTAL	179.05	93.761
			POTENTIAL ³	398.20	200.22

1. From ECS, (4, 5); and Soil Conservation Service (27).

2. 1976 calculations only are listed because of unexplained variability between 1975 and 1976 data.

3. Values assume 1.00 range condition.

In addition, the vegetation was analyzed as to nutrients of the various species. This data shows that the native vegetation of Colstrip area usually has adequate nutrients. However, molybdenum has been shown to accumulate in legumes which can subsequently produce toxicity symptoms in livestock using them. Munshower and DePuit have verified high levels of molybdenum in yellow sweet clover, and higher concentrations are suspected for other legumes.

The optimum range for zinc and copper in forage are 30 to 50 mg/kg and 4 to 10 mg/kg respectively. The zinc and copper levels for annual and perennial grasses were reported to be approximately 20 mg/kg and 4 mg/kg, respectively (Munshower and Neuman, 1977). Zinc concentration in sagebrush was reported to be about 40 mg/kg. Grasses alone may be deficient for the copper and zinc requirement. Therefore, silver sage or other plant species with higher zinc and copper concentrations may be important as supplements in the diet of range livestock in the area.

2. Wildlife

a. General Description

Wildlife species in area A and E are typical of the Colstrip area. Game species observed on areas A and E include mule deer, whitetail deer, antelope, sharptail grouse, and pheasants.

Wildlife studies have been conducted in the area by Ecological Consulting Service (1973a, 1975a, 1975b, 1976b). Recent data for the Colstrip vicinity (Ecological Consulting Service, 1976b) indicate mule deer have a preference for the ponderosa pine/grassland habitat types and skunkbush/grassland habitat types. The grassland habitat type is the only vegetation type which exhibited a negative preference; in other words, the animals were less likely to be observed using this type of vegetation than any other type of cover.

Whitetail deer are confined primarily to creek bottom habitat types in the region, however, very few were observed along Armells Creek.

Antelope in the area prefer the open grassland areas and sagebrush/grassland habitat types. According to the E.C.S. only the big sagebrush/grassland habitat is preferred by antelope in the region.

In similar analysis, game bird species such as the sharptail grouse and pheasant were also identified with particular habitat type preferences during certain seasons of the year, such as native shrub coulees. No sharptail dancing grounds have been observed in either area A or E. Data for ring-necked pheasant distribution indicates that such birds are commonly found in the vicinity of Colstrip and are associated with the bottom-coulee areas along Armells Creek.

Waterfowl species also occur in the region although waterfowl habitat within areas A and E is quite limited. The standing water in the old spoils pits may provide some resting habitat for waterfowl

species. The East Fork of Armells Creek is extensively used by waterfowl.

Many other wildlife studies have been conducted in the region by the Department of Fish and Game, the U.S. Fish and Wildlife Service, and the Environmental Protection Agency. The non-game wildlife species in the study area are large in number and occur in a variety of specific habitat types. No prairie dog towns are located in areas A or E and there are no known raptor nests in the immediate permit areas. The species of wildlife in the area are listed in Appendix D.

Wildlife problems in the Colstrip vicinity are related to poaching and intrusions on private land by hunters. The increased population of the town of Colstrip probably has contributed to an increase in the poaching problem of the area. The wildlife distribution in the vicinity of Colstrip recorded by the observation of E.C.S. (1975b, 1976b) shows that animals are less numerous in the immediate area around Colstrip than in other areas in the region. This difference in distribution may be caused, in part, by loss of habitat due to mining, but appears to be more related to the population concentrations in the immediate area of Colstrip. There does not appear to be a similar effect on the distribution of wildlife caused by the Peabody Coal's Big Sky Mine which is located in the same region.

b. Quantitative Wildlife Data

Quantitative data available for the study area is confined primarily to the game animals. Productivity indices, food habits, parturition sites, and population estimates are available for mule deer and pronghorn antelope. The small number of whitetail deer in the area do not allow estimates of the actual populations. Data on the distribution and association of mule deer and pronghorn antelope with the different habitats in the area

are also available (Ecological Consulting Service 1973a, 1973b, 1975a, 1975b, 1976b). The importance of the various plant species of the region for food and also for cover are depicted in the data presented in these publications. Silver sage (Artemisia cana) was very heavily used for food during winter and early spring observations. Big sage was quite important for the antelope populations in the area as they were most frequently observed in this vegetation type. Silver sage is also very important for antelope during the winter months, as 99% of the observed usage of plants was this species. Most of this data has been collected in the general Colstrip vicinity, but should equally apply to areas A and E.

Other game animals for which quantitative data is available include sharptail grouse and the ring-necked pheasant. Populations of sharptail grouse were estimated by extrapolating from the numbers of grouse occurring on the leks of the region during the spring. Using this method E.C.S. estimated the population to be 3.5 sharptails per square mile in the region immediately around Colstrip. Observations of white-tail deer, sage grouse, pheasants, hungarian partridges, coyotes, and red foxes within the region around Colstrip have also been recorded. Coyotes and pheasants are rather common but the other species are infrequently observed in the region. Pheasant crow counts were conducted in the vicinity of the creek bottoms along Armells Creek. Three years of data available for the area indicate the number of pheasants is apparently low, particularly when compared with the Rosebud Creek area.

Some data on small mammals are also listed by E.C.S. (1975b) and, other authors have commonly collected the grasshopper mouse, Onychomys leucogaster, the harvest mouse, Reithrodontomys megalotis, and olive-backed pocket mouse, Perognathus fasciatus, (Lewis, Morton and James 1976).

Wildlife data available specifically for the permit areas A and E is minimal. E.C.S. (1975a) reported observation data of both antelope and deer within areas A and E. Sharptail grouse and ring-necked pheasants have also been observed. Actual observation data available for the specific area A and E are too small to make any conclusion as to the importance of the vegetation within these areas for wildlife species. It can be assumed, however, that the vegetative community types could potentially support populations of wildlife typical of the Colstrip region. Possible exception may be made for the deer and antelope species of the area due to human impacts from the town of Colstrip, such as poaching, off road vehicle use, or domestic pets, which may have a behavioral influence on the animals and restrict actual numbers in the area.

3. Aquatic Biology

a. General Discussion of Aquatic Ecosystem

Fish species in the coal pits in the northwest portion of area E probably include black bullhead (Ictalurus melas), walleye (Stizostedion vitreum), northern pike (Esox lucius), pumpkin seed (Lepomis gibbosus), yellow perch (Perca flavescens) and rainbow trout (Salvelinus gairdneri), (Ecological Consulting Service, 1973a). Armells Creek apparently has no significant fishery and is an intermittent stream. E.C.S., 1973a, also lists aquatic insects located in one coal pit pond in the area. The insects in the coal pit include typical warm water pond forms of which mayflies, aquatic beetles, midges, and dragonflies are the most abundant. The fishery in the coal pit pond adjoining area E has not been used for at least the past year, since Western Energy has been anticipating mining the area.

4. Summary

Areas A and E are typical of the region around Colstrip in terms of wildlife species, aquatic resources and vegetative communities. In terms of value of the land for agricultural purposes, the cultivated lands of area A would be considered more valuable than adjoining native range. Income per acre from agricultural lands producing winter wheat crops would be considerably above the income per acre achieved on adjacent grazing lands used for livestock production.

The aesthetic values of the area are primarily derived from the topographical affect of the sandstone and scoria outcroppings in the steeper areas and the ridge top ponderosa pine/savannah forests. There are no stream bottom forests or other riparian vegetation that would be disturbed under the present mining plans.^{1/}

The most unusual vegetative features within the two proposed mine areas occur in area E. Along the northwestern boundary of this area, there is a series of graded spoils piles dating back to 1924. Because of their uniqueness, these areas have been of prime concern to researchers of the region (see Appendix D) . The spoils were graded in 1924 and thus have a history of 50 years of natural revegetation with variable grazing pressure. The only other area in southeastern Montana that has a similar history is the nearby Cape Oliver site which is composed of spoils piles that were regraded in 1932. There are no plans to mine the Cape Oliver site as no mineable coal remains at the site.

At the Cape Oliver site, the vegetative community has become fairly well established and is quite similar to the adjoining range lands. The

^{1/} Winter wheat crop yields in the Colstrip area during the last few years of favorable weather have been approximately 35-40 bushels/acre.

1924 spoils piles, however, have plant communities in earlier stages of succession. The importance of determining the reasons for these differences is aptly described by Brian Sindelar in Appendix D.

The diversity and abundance of wildlife species in the Colstrip area are directly dependent on the native vegetation. As the wildlife species present are generally dependent on the diversity of natural community types in the area they have developed use patterns on the different community types which vary with the seasons. Particularly for mule deer and antelope, the shrub species have been demonstrated to be quite important. Ponderosa pine also provides cover for mule deer. Bottom coulee areas are important cover areas for sharptail grouse and other species, while agricultural lands such as the winter wheat fields and alfalfa in area A are often used by many different species. Both antelope and deer will use alfalfa fields and sharptail grouse, pheasants, and hungarian partridges often use the wheat fields for a food source during certain seasons. However, all these species require adjoining native vegetation in order to continue their existence in the area.

Many non-game species in the area are also dependent on particular vegetation types. For example, the rock wren requires sandstone outcroppings for nesting habitat while the Brewer's sparrow nests in big sage.

Apparently, livestock also require a diversity of natural vegetation types to maintain proper nutrition. For example, excessive consumption of legumes could result in molybdenum toxicity, because this element tends to accumulate in these plants. The background low levels of zinc and copper in the native range grasses of the region suggest that a partial diet of the shrub or forb species of the area, may be required to supplement livestock intake of zinc and copper.

C. Human Environment

1. Population

The population of Rosebud County declined by over 500 persons from 1950 to 1970 (table 21). Most of the decline during the 1950's was due to the closing of the Colstrip mine and the loss of the associated railroad activity. During the 1960's increasing productivity in agriculture caused further population losses, although at a slower rate. These population decreases were by no means proportionately distributed throughout the county. In fact, in the 1950's the population of Forsyth increased by 126 and areas within or near the Northern Cheyenne Reservation showed substantial increases in population although the county's total population declined by 383. This indicates that a large part of the loss came from farms and ranches in rural areas.

The population of Rosebud County has become more concentrated in the under-twenty age group since 1950, increasing from 38.8 percent in 1950 to 42.2 percent in 1970 (table 22). Furthermore, the percentage of non-whites increased from 21.9 percent in 1960 to 30.3 percent in 1970. During this period the total population fell by 155, however, the non-white population increased 476.

Such data show a substantial change in the population composition of Rosebud County from 1950 to 1970. There are two reasons for this. First, fertility rates for Indian women are substantially higher than that for the rest of the county's population, resulting in a greater rate of increase of Indians than non-Indians in the young age groups (table 22). Secondly, since the Northern Cheyenne people have a strong cultural attraction to the area, they are more reluctant to move from the county in response to changing economic conditions than are their non-Indian counterparts. In other words, when economic activity is insufficient to support the resident population, a higher portion of

Table 21.-- Population of Rosebud County and six communities, 1950, 1960, 1970

<u>Area</u>	<u>1950</u>	<u>1960</u>	<u>% Change 1950-1960</u>	<u>1970</u>	<u>% Change 1960-1970</u>	<u>% Change 1950-1970</u>
Rosebud County	6570	6187	-5.8	6032	-2.5	-8.2
Ashland	100	150	-50.0	400	166.7	300.0
Birney	50	20	-60.0	15	-25.0	-70.0
Forsyth	1906	2032	6.6	1873	-7.8	-1.7
Lame Deer	350	300	-14.3	1100	266.7	214.3
Rosebud	250	140	-44.0	100	28.6	-60.0
Ingomar	80	65	-18.7	50	-23.1	-37.5

Sources: U.S. Bureau of the Census, Census of Population: 1950: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1952).

U.S. Bureau of the Census, Census of Population: 1960: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1963).

U.S. Bureau of the Census, Census of Population: 1970: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1973).

Table 22.-- Age distribution of Rosebud County population, 1950, 1960, 1970

Age	1950		1960		1970		1976	
	Percentage of Total Population	Percentage of Total Population	Percentage of Total Population	Percentage of Total Population	Percentage of Total Population	Percentage of Total Population	Percent Nonwhite	
0-5	12.8	13.0	10.1	47.9	10.1	31.1	31.1	
5-9	10.1	11.8	11.4	42.7	10.1	32.3	32.3	
10-14	8.4	11.1	11.7	36.3	10.2	33.4	33.4	
15-19	7.5	7.7	9.1	37.6	9.6	28.5	28.5	
20-24	7.1	4.7	6.2	31.5	8.8	19.4	19.4	
25-29	7.1	5.2	6.4	34.1	9.8	15.8	15.8	
30-34	7.1	5.8	5.1	31.1	7.1	19.3	19.3	
35-39	6.5	6.3	5.1	26.0	5.9	18.1	18.1	
40-44	6.1	6.3	5.5	24.1	5.2	18.9	18.9	
45-49	5.0	5.3	5.5	22.8	5.2	16.1	16.1	
50-54	4.6	4.7	5.3	17.2	5.2	14.0	14.0	
55-59	5.3	4.1	4.6	17.1	4.1	15.5	15.5	
60-64	4.4	3.3	3.6	13.4	2.9	12.3	12.3	
65+	7.8	10.4	10.2	10.4	5.8	10.8	10.8	

Sources: U.S. Bureau of the Census, Census of Population, 1950: Characteristics of the Population, Montana Office, 1952). U.S. Government Printing

U.S. Bureau of the Census, Census of Population, 1960: Characteristics of the Population, Montana Office, 1963). U.S. Government Printing

U.S. Bureau of the Census, Census of Population, 1970: Characteristics of the Population, Montana Office, 1973). U.S. Government Printing

U.S. Bureau of the Census, Special Census of Rosebud County: January, 1976, unpublished.

the non-Indian segment will migrate from the county than Indian. With the net immigration that has occurred in the County since 1970, the proportion of the population that is Indian has decreased.

A Special Census of Rosebud County completed in January of 1976 (U.S. Bureau of Census, 1976) found that the population had increased by more than 50 percent since 1970 (to 9,578). Table 23 shows the county population for 1970 and 1976 as well as for interim years.^{1/}

2. Employment

There was little change in the level of total employment in Rosebud County between 1950 and 1970 (table 24). Employment declined by 96 during the 1950's, but then increased 120 in the sixties, resulting in a net gain of twenty over the two decades. As the county population decreased by over 500 during the same period, this indicates that a greater percentage of people were working in 1970 than in 1950.

^{1/} Rosebud County population estimates for 1970 to 1976 (U.S. Bureau of Census, 1976 and table 23) were derived by a method of questionable precision when applied to counties experiencing rapid growth. The Bureau of Census allocates a part of its national population estimate to Montana which is referred to as the control total. Then, using various indicators from a group provided by the Census, the control total is allocated to the 56 counties in Montana. Since this procedure uses such data as births, deaths, vehicle registrations and utility connections, sources of error are inherent. If the state control total is too low, the county's population estimate will tend to be understated. The crucial factor, however, is related to the variables used in the allocation process. Since many of the new people mining in Rosebud County from 1970 to 1976 were involved in the construction of Colstrip electric generating units 1 and 2, a large percentage may have only been in the county for a year or less, and the more transient residents may not be adequately reflected in the allocation variables. As a consequence the population will be underestimated. This appears to have been the case in view of the Special Census count in 1976.

Despite the fact that there are such sources of error in the 1976 Special Census, the method used is the best and most consistent available.

Table 23.-- Population of Rosebud County 1970 - 1976

<u>Year</u>	<u>Number</u>	<u>% Change</u>
1970 ^a	6032	--
1971	6100	1.1
1972	6300	3.3
1973	6900	9.5
1974	7700	11.6
1975 ^p	8600	11.7
1976 ^b	9578	24.4
Change Between 1970-1976	3543	58.7

p Preliminary

a Census of the Population - 1970

b Special Census, January 23, 1976

Sources: U.S. Bureau of the Census, Census of the Population: 1970: Characteristics of the Population, Montana (Washington, D.C., U.S. Government Printing Office, 1973).

U.S. Bureau of the Census, "Population Estimates and Projections," Current Population Reports, Series P-25 (Washington, D.C., U.S. Government Printing Office).

U.S. Bureau of the Census, Special Census, unpublished data.

U.S. Bureau of the Census, Special Census of Rosebud County, unpublished data.

Table 24.-- Employment in Rosebud County by industry, 1950, 1960, 1970

Industry	1950		1960		1970	
	Number of Persons Employed	Percentage of Total	Number of Persons Employed	Percentage of Total	Number of Persons Employed	Percentage of Total
Agriculture	928	41.9	693	32.7	511	22.8
Mining	108	4.9	10	.5	63	2.8
Construction	109	4.9	69	3.2	117	5.2
Manufacturing	31	1.4	62	2.9	174	7.8
Railroad	257	11.6	173	8.2	101	4.5
Other Transportation, Communication, and Public Utilities	42	1.9	62	2.9	50	2.2
Trade	271	12.2	364	17.2	315	14.1
Finance, Insurance, Real Estate	24	1.1	26	1.2	53	2.4
Services	160	7.2	240	11.3	208	9.3
Education and Public Administration	222	10.0	271	12.8	419	18.7
Other	62	2.8	148	7.0	227	10.1
TOTAL	2214	100.0	2118	100.0	2238	100.0

Sources: U.S. Bureau of the Census, Census of Population: 1950: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1952).

U.S. Bureau of the Census, Census of Population: 1960: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1963).

U.S. Bureau of the Census, Census of Population: 1970: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1973).

Employment in agriculture steadily declined from 1950 to 1970 (table 24). In 1970, 511 persons were engaged in agricultural endeavors, over 400 less than in 1950. Much of this decline, however, reflects the general agricultural trend toward larger and more capital-intensive operations and does not mean that there was proportionately less activity in the county. Nevertheless, declining agricultural employment did contribute to a lower population of Rosebud County.

The mining sector exhibited considerable volatility in the county during the 1950's and 1960's, declining from 108 in 1950 to 10 in 1960, and then increasing to 63 in 1970. The closing of the Colstrip mine in 1957 caused part of the decrease during the fifties and resulted in similar reductions in railroad employment. Renewed interest in Colstrip with the opening of the Big Sky mine in the sixties resulted in a small gain in mine-related employment by 1970.

According to the U.S. Bureau of Census (1970), 411 Northern Cheyenne were employed in Rosebud County in 1970. This represents only 18.4 percent of the total employment although the county population was 30 percent Indian. Of the 411 employed Northern Cheyenne's, over 60 percent, worked either in services or government. The other principal Indian employer was manufacturing.

The U.S. Census Bureau's 1970 Rosebud County unemployment rate of 4.6 percent is somewhat misleading, as the rate for non-Indians was only 2.9 percent while it was almost 13 percent for the Northern Cheyenne. Furthermore, the census figure did not take into account the many who had dropped out of the labor force due to the lack of adequate employment opportunities.^{1/}

^{1/} This is generally referred to as hidden unemployment.

As mentioned above, the closing of the Colstrip mine in 1957 reduced the need for a railroad work force in Rosebud County. Railroad employment reductions continued through the sixties as the importance of the railroad diminished nationally, mechanization increased, and railroad companies concentrated their operations in other locations. In 1950, railroad employment in Rosebud County was 257; by 1970, such employment had been reduced to 101 (table 24).

Manufacturing employment in Rosebud County increased from only 31 in 1950 to 174 in 1970. The increase was largely the result of the county becoming a primary source of railroad ties during the 1950's and the opening of a plastics manufacturing plant in the late 1960's.

Although employment in many of the primary industries in the county declined, employment between 1950 and 1970 in the service and trade sectors can be explained by the increased employment in agriculturally-oriented enterprises and by the expansion of government activity in the county. The increases must be interpreted carefully, however, since hourly earnings in these sectors are usually low and employment is often on a part-time basis.

The largest employment gain between 1950 and 1970 occurred in education and public administration employment. Education employment accounted for much of the change due to increasing numbers of children in the county placing additional demand on the schools. The federal government, through the Bureau of Indian Affairs, also increased the number of on-going programs on the Northern Cheyenne Reservation.

The best source for employment data for Rosebud County since 1970 is the Bureau of Economic Analysis (BEA) of the Department of Commerce.^{1/}

Such data for the period 1970-1974 are presented in table 25 and indicate that total employment has increased by over 1,000 during the four-year interval. As expected, mining and construction have increased the most as a direct result of the coal-related activity at Colstrip. Mining employment rose from 42 to 283 and construction employment increased from 29 to 180 (construction employment estimates are probably low since there were more than 180 construction jobs associated with Colstrip electric generating units 1 and 2).

Manufacturing, which rose from 213 (employed persons) in 1970 to 264 in 1973 and fell to 180 in 1974, was the only other basic employment sector to experience much change during the 1970-1974 period. Most of this fluctuation can be traced to the workforce at Guild Arts and Crafts and to the fire at the Eastmost Lumber Company in 1973, both of which are located in Ashland.

Other supporting sectors experienced large gains in the four-year period with the largest increase in the service-related jobs (table 25). Much of this gain can be attributed to increases in employment in welfare, religious and nonprofit organization on or near the Northern Cheyenne Reservation.^{2/} The remainder of the increase in the services sector, as

^{1/} There are, however, definitional differences between the BEA data for 1970-1974 and the U.S. Census data for 1950-1970 that must be reconciled. The Census data (table 24) counts the number of persons working, while the BEA data (table 25) counts the number of jobs. If for example, a person has two jobs, employment will be recorded by the Census as one (employed person) but by the BEA as two (job). Such differences are described in more detail in Appendix F.

^{2/} Such organizations include the St. Labre school, tribal employment, churches, and various social groups, etc.

Table 25. -- Employment in Rosebud County by industry, 1970-1974
 (From U.S. Dept. of Commerce, Bureau of Economic Analysis
 unpublished data)

<u>Sector</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Agriculture ^a	697	714	709	701	714
Mining	42	79	103	266	283
Construction	29	25	39	76	180
Manufacturing	213	229	264	191	180
Transportation, Communication, Public Utilities	184	181	187	190	205
Trade	216	242	267	330	346
Finance, Insurance, Real Estate	19	26	37	42	52 ^e
Services	395	514	562	645	672
Government	442	462	474	491	544
Other ^a	309	320	334	334	335 ^e
TOTAL	2546	2792	2976	3266	3511

^aIncludes self-employed proprietors.

^eEstimated.

well as the changes in trade and government employment, was a direct result of increased economic activity in the county.

3. Income

The slow growth of the Rosebud County economy from 1950-1970 is also reflected in the income data for the county (table 26). Although both total income and per capita income in the county were growing, they were not keeping pace with the rest of the state. In addition, this was a period when Montana's income was not growing as fast as the national average, thus compounding the problems of Rosebud County.

For 1950, 1960 and 1970, the median income level in Rosebud County was far below the Montana average (table 27).^{1/} This is further emphasized by the fact that in 1970, 20 percent of all families and 25.8 percent of all persons in Rosebud County had incomes below the poverty level, as defined by the U.S. Bureau of the Census (table 28). Furthermore, 14.6 percent of families and 18.8 percent of all persons in the county had incomes that were less than 75 percent of the poverty level. Comparative state poverty levels are shown in table 28. Even though total employment in Rosebud County increased between 1960 and 1970, personal income and income per capita fell relative to the Montana average as a result of a shift in employment to lower paying jobs.

As with employment data, the BEA is the only source of income data for Rosebud County after 1970 (table 29). The income figures presented in table 29, however, do not include nonlabor income such as dividends, interest, rent or transfer payments, and they have not been adjusted for

^{1/} Median family income is that income level for which there is an equal number of families above and below.

Table 26. -- Personal income for Rosebud County and
the State of Montana, 1950, 1959, 1970
(From U.S. Dept. of Commerce, Bureau of
Economic Analysis, unpublished data)

	<u>1950</u>	<u>1959</u>	<u>1970</u>
Montana	962.0	1345.0	2442.0
Rosebud	10.0	12.7	20.8
Percent of Montana	1.0	.9	.8
<u>Income per Capita</u>			
Montana	1622	2010	3517
Rosebud	1510	2077	3448
Rosebud/Montana	.93	1.03	.98

Table 27. -- Median family income for Rosebud County and the State of Montana, 1950, 1960, 1970

	<u>1950</u>	<u>1960</u>	<u>1970</u>
Rosebud County	2524	4399	6717
Montana	3292	5403	8512
Rosebud/Montana	.767	.814	.789

Sources: U.S. Bureau of the Census, Census of Population: 1950: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1952).

U.S. Bureau of the Census, Census of Population: 1960: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1963).

U.S. Bureau of the Census, Census of Population: 1970: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1973).

Table 28. -- Poverty level of population, Rosebud County and the State of Montana, 1970

	<u>Rosebud County</u>	<u>Montana</u>
Percentage of families below poverty level	20.0	10.4
Percentage of persons below poverty level	25.8	13.6
Percentage of families below 75 percent of poverty level	14.6	6.4
Percentage of persons below 75 percent of poverty level	18.8	8.5

Source: U.S. Bureau of the Census, Census of Population: 1970: Characteristics of the Population, Montana (Washington, D.C.: U.S. Government Printing Office, 1973).

Table 29. -- Labor income by sector in Rosebud County, 1970-1974
 (Thousands of current dollars)
 (From U.S. Dept. of Commerce, Bureau of
 Economic Analysis, unpublished data)

<u>Sector</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Agriculture ^a	5766	6036	7972	11985	3700
Mining	555	807	1104	3620	3888
Construction	232	129	302	790	2863
Manufacturing	935	1102	1126	917	1018
Transportation, Communication, Public Utilities	1574	1649	1827	2077	2247
Trade	715	825	928	1185	1713
Finance, Insurance, Real Estate	88	132	193	235	366
Services	1539	1916	2347	2641	3308
Government	2481	2835	3093	3478	4086
Other ^a	<u>1249</u>	<u>1193</u>	<u>1196</u>	<u>1258</u>	<u>1412</u>
TOTAL	15134	16624	20088	28186	24601

^aIncludes self-employed proprietors.

inflation. The large changes in agricultural income were a result of changes in inventory valuation figures used by BEA and should not be construed as realistically representing changes in agricultural activity in Rosebud County. For the most part, the sector incomes exhibit a pattern similar to the employment data. An analysis of sector incomes per employee is given in Appendix E.

4. Land use

Rangeland is the predominant land use in the Colstrip area. Figure 19 shows land use in and adjacent to the two proposed mine areas while tables 30 and 31 give acreage figures for land uses in both Rosebud County and the Northern Cheyenne Indian Reservation respectively. In Appendix E Yellowstone River Subbasin land use is shown.

Mining is currently occurring in the north and east portions of Area E. To the east of Area E there is generally rangeland (fig. 19); more rangeland abuts Area E to the south, and some farmland and more mining occur to the southwest. Colstrip electric-generating Units 1 and 2 and related heavy industrial land uses are located to the northwest of Area E adjacent to the area presently being mined; the community of Colstrip also lies to the northwest.

Area A is located west and slightly north of Area E; the Colstrip urban area lies directly east of and adjacent to Area A (fig. 19). A surge pond for the electric-generating unit is located near the northeast corner of Area A. The remainder of Area A is surrounded by rangeland. Inside Area A there is currently both farming and mining land use. A railroad spur extends along the southeast edge of Area A.

Figure 19

LAND USE

- Residential
- Mobile Homes
- Commercial
- Institutional
- Agricultural
- Park & Open Space
- Mining
- Heavy Industry
- Power Plant
- Vacant

MINING AREA BOUNDARIES

ROSEBUD MINE
Colstrip, Montana

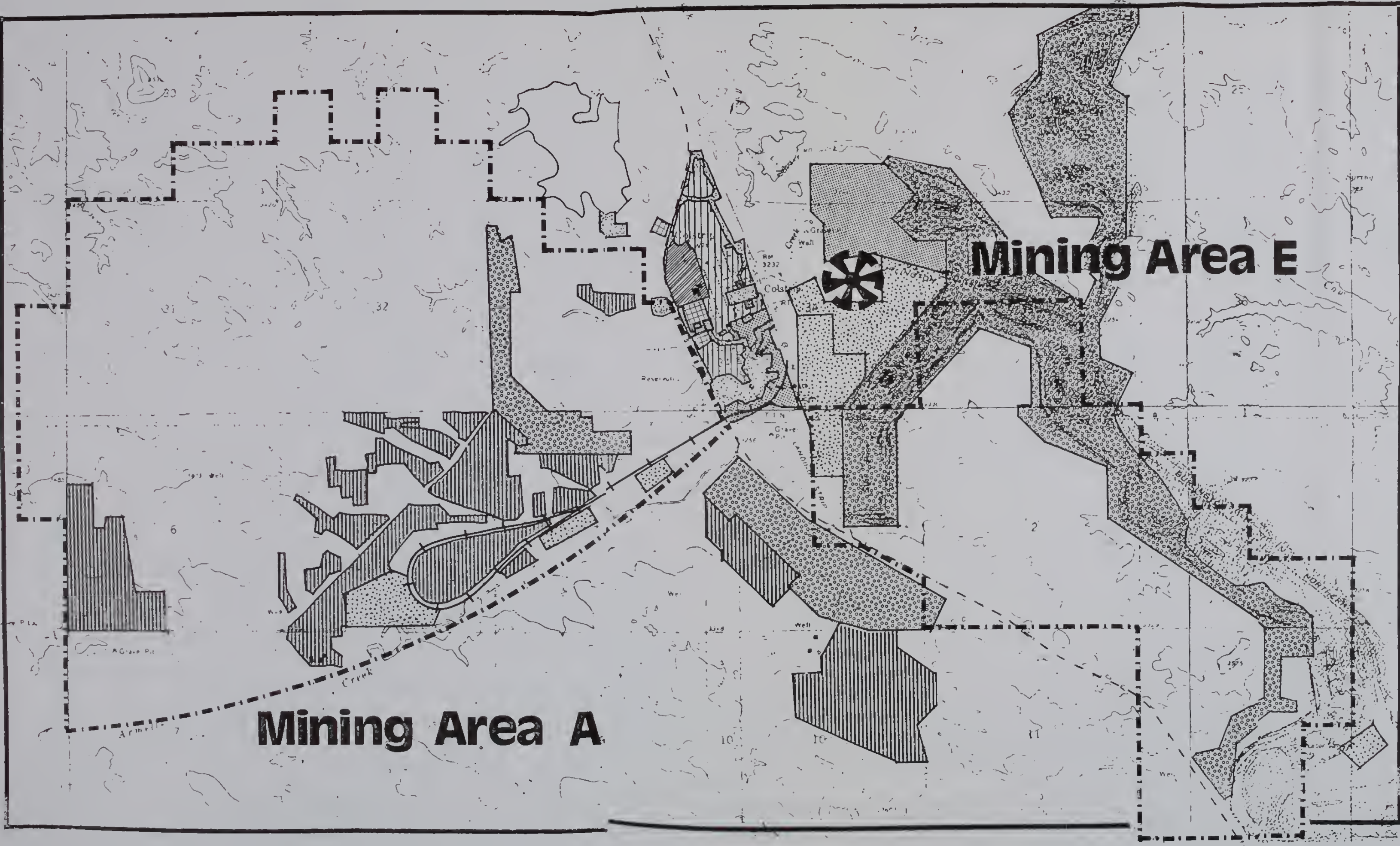
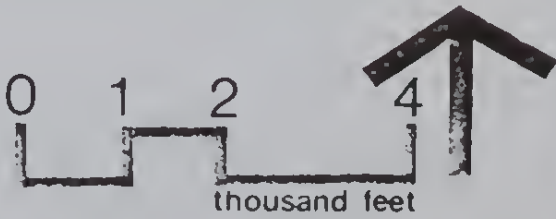


Table 30. -- Rosebud County land use, 1976

<u>USE</u>	<u>ACRES</u>
Total Acreage of County	3,220,480
Northern Cheyenne Reservation	433,600
in Rosebud County	235,825
in Big Horn County	197,775
Range and Pasture Land	2,500,294
Cropland	129,900
Irrigated	31,500
Dryland (Fallow & Crop)	98,400
Wheat	38,500
Barley	9,650
Oats	3,000
Corn	7,450
Sugar Beets	1,210
Hay (all)	36,000
Other (Beans, Speltz, Potatoes, etc.)	580
Miles of Country Road	14,025
Woodland (Timber)	219,690
Suburban Tracts	830
Industrial Sites	1,260
Water Area	8,250

Source: Eldon Rice, Rosebud County Planning Coordinator,
Forsyth, Montana; letter, March 1, 1977.

Table 31. -- Approximate acreage in various land uses on the Northern Cheyenne Reservation, 1976

	<u>Tribal or Trust Status</u>	<u>Nontrust Status</u>	<u>Total</u>	<u>Percentage</u>
Forest land	129,808	2,062	131,870	30
Parks and recreation	466*	40*	506	1
Water resources	238*	--	238	1
Cropland	13,471	1,174	14,645	3
Rangeland	290,130	5,972	296,102	66
Urban or residential	746	--	746	1
Right-of-way	2,677*	--	• 2,677	1
TOTALS	437,536	9,248	446,784	100

Note: Some overlap in these figures may occur due to natural conditions and report conflicts.

Source: Eldon Rice, Rosebud County Planning Coordinator,
Forsyth, Montana; letter, March 1, 1977

5. Social structure

Recent socioeconomic studies of the southeastern Montana area include Jobes and Parsons (1975), University of Montana Institute of Social Science Research, 1974, Mountain West Research, 1975, University of Montana Community Service Program, 1975 and Westinghouse Environmental Systems, 1973.

The Colstrip area, and Forsyth - the county seat, 37 miles to the northeast, have experienced relatively rapid population and general development growth over the last seven years caused by increased mining activity and construction of the two electric generating units at Colstrip. This transitional period and its effect on the area's social structure is not over yet, although growth has stabilized and even declined somewhat. To the existing social structures of the ranchers and farmers, the Indians, and the small town populace must be added that of the newcomers, the workers and their families who have moved to the mining area. Although an extensive demographic study has been made of such workers, specific social characteristics other than generalities are probably as diverse as the origins of the work force.^{1/} Exactly what the social structure of the area is at any given point in this transition is extremely difficult to assess, even though the need for it and the general lack of pertinent data is known (U.S. Bureau of Land Management, Forest Service, 1972). When it was felt that social analyses should be conducted in the

^{1/} For an analysis of the socio-economic characteristics of the worker at large energy-related developments in the western United States which includes commuting patterns, residential preferences, and social integration, see the ten documents of The Construction Worker Profile prepared by Mountain West Research, Inc., for the Old West Regional Commission in 1975.

Colstrip--south central Montana are, the process of social change had already started, and consequent societal analysis are limited before they start by having to deal with a social structure already in relatively rapid transition.

A good overview of the social makeup of the Northern Great Plains (NGP) area which includes Colstrip and its environs is made in the 1975 North Great Plains Resources Program report (1975).

"Social change is a very complex process and it affects individuals differently as well as the communities in which they reside. The use of the land, be it for agriculture or recreation, is fundamental to the culture and way of life of persons who live in the NGP. The social system and culture of the NGP is dominated by three distinct groups of people: Farmers and ranchers, townspeople, and Indians. The first two groups share one culture, while the Indians have a separate, yet related, culture.

Coal development will accelerate the urbanization process that is occurring in the NGP region. Urbanization is not simply the growth of population, but a process. To understand the impact of coal development on the culture and lifestyle of the NGP residents, an understanding of the process of urbanization and its impact on a rural society is necessary. The term 'urbanization' can be described as a process which changes the way people relate to one another. As urbanization occurs, residents become less oriented toward other individuals in the community and more oriented toward institutions and extra-community forces. It includes a general decline in local autonomy, exposure to different norms, and a fragmenting of the existing social order and the building of a new one.

The non-Indian culture and way of life is centered around two features--the community, which is generally small, and the agrarian nature of the society. The persons who live in the area are accustomed to a generally slow pace of living, relatively little congestion, a well-established sense of community where individuals are known and most face-to-face contact is with familiar persons. There are differences, nevertheless, there is still an appearance of similarity of interests and values. Agriculture has long been the principal economic force in the area and the region's culture is firmly rooted in the American agricultural ideology.

Initially, the impacts of urbanization will be greatest on the persons and communities closest to the actual development sites, with the impacts then diminishing in a descending scale with distance from the development site. In the long

run, however, all persons in the area will be affected to some extent. The smaller the scale of development, the more likely it is that the impacts will be localized.

Within the development areas, there are differences of opinion concerning coal development. One rancher may sell or lease his ranch and his neighbor may feel betrayed. Some residents feel that their lifestyles will be destroyed, whereas others feel that development will be beneficial. Differences of opinion have touched nearly every person in the development areas, and have spread throughout the United States. Confusion reigns supreme, and within the development areas rumors spread like prairie fires. There is, however, one common denominator shared by most residents of the NGP: They know coal development will affect their lives--but they are not certain as to the degree and nature of impact."

An underlying assumption that has been made is that many of the people surrounding Colstrip area are generally conservative in cultural, religious, and general social matters, and a characteristic which may be most applicable to those residents who have lived in the area for longer than seven years. The attitudes of such individuals and of groups and institutions toward strip mining are primarily shaped by a number of factors including acceptance of a land ethic philosophy, distaste of aesthetic values destroyed or sullied, and the impatience with the length of time required to recreate naturalistic environments once land has been strip mined (Callahan and Callahan, 1971). One view of the rural resident who has lived on the land for three generations is indicated by Toole (1975) who found an ingrained antagonism toward the federal government, a tradition passed from father to son, which held that "Eastern-oriented" land and water policies were contemptable because they were based on total ignorance of the implications when applied to the local area.⁸ A direct extrapolation of the general federal land and water policies attitude can be applied to the coal development activity currently being conducted in the southcentral Montana area.

The Indian inhabitants, long-time residents of the area, are also conservative, especially in ways that involve land uses and occupation.

Basically, man is part of the natural environment to their point of view and derives much of his identity from interaction with the world about him. Opposition to coal development by the Northern Cheyenne Indians, as materialized in June, 1973, is partly based on fears that the familiar natural world will be despoiled and irrevocably altered by strip mining--especially within the confines of their reservation which lies about 22 miles from the Colstrip area (U.S. Bureau of Land Management, undated). The relationship of man and the land, or the distinction of man in his environment--or the lack thereof-- is emphasized by Jobes (1975). This analysis emphasized that social impacts involve more than the socio-demographic alterations upon an indigenous population. Rather, "--alterations in the way of life, interactions systems, i.e., social factors reflecting choice, may constitute the most profound impacts upon the social environment.

6. Social services

a. Colstrip

(1) Housing

Since the construction of Colstrip generating Units 1 and 2, the housing shortage experienced during peak construction activity has eased. The present housing situation (table 32) is characterized by the sale of about one house a week. This appears to be governed more by prevailing market conditions than anything else. According to WECO, as rental housing units become vacant, they are placed on the market for sale. The sale price is established by taking the average of a Federal Housing Administration appraised value and that of an independent appraiser. Buyers who have lived at Colstrip for one year and who work for one of the companies operating the mining, generating and related facilities--or who teach school in Colstrip--are given a credit (of one year's rent) toward buying a home (personal communication, Martin White, WECO).

(2) Water system

The Yellowstone River is presently the major source of Colstrip's water supply. Under an agreement with the Montana Power Company, the town may use up to 1000 gallons per minute (gpm) of the water that the company draws from the river. In addition, water is drawn from six wells which together can pump 140 gpm. These wells are used at night to supply water to the system when the treatment plant is shut down and usage is low. These two supply sources give the town a total of 1140 gpm, or 1.4 million gallons per day, which is adequate for present demands. Current usage may approach 1.4 million gallons per day (gpd) at peak periods so it is expected that any major population influx may cause shortages.

Colstrip has a water storage capacity for municipal use of 600,000 gallons; an elevated storage holds 100,000 gallons with the balance stored in a reservoir near town.

Table 32. -- Colstrip housing disposition - March 16, 1977
(Written communication, Western Energy Co.,
March 16, 1977)

Single-Family Housing Units

63 old houses	120 new houses
2 for sale (all owned by WECO)	12 privately owned
5 sold	4 for sale (all owned by WECO)
56 rented (all owned by WECO)	104 rented (all owned by WECO)

Multi-Family Housing Units (all owned by WECO)

40 - 4 plex units	24 - 8 plex units
4 vacant	1 vacant
36 rented	23 rented

Trailer Courts (all owned by WECO)

166 permanent lots	527 temporary lots
3 vacant	307 vacant
163 rented	220 rented

Housing Lots (all owned by WECO)

16 developed lots
1 sold
15 for sale
38 undeveloped lots (platted)
45 undeveloped lots (platted
as residential area but
not subdivided)

The town's water treatment plant has a maximum capacity of 1000 gpm, or in a 24-hour period, 1.4 million gallons. The plant and the town's distribution system are in good condition. Again, any major population increases may cause demands to outstrip the town's ability to supply water.

(3) Waste disposal

Colstrip has a three-cell lagoon sewage treatment system with a total of ten surface acres. The system was designed for a population of 1,200 or about 120,000 gpd. Currently, the average sewage output is estimated to be 825,000 gpd.

Construction of an oxidizing ditch to improve the quality of discharge or effluent is planned.

The collection system is in good condition. The pipes are considered adequate and they were cleaned, checked, and repaired in 1975.

Colstrip operates a state qualified landfill for the use of the town's residents, school, and shopping area. The capacity is virtually unlimited; it is a spoils pit at the adjacent mine.

Garbage is collected in the residential area twice a week except for the construction worker dormitory, the trailer site, and the cafe where it is collected every day. School collection is made upon request.

(4) Police department

Law enforcement is provided by the County Sheriff's Office which has three deputies stationed in Colstrip. There is no jail in the town and prisoners are transported to facilities in Forsyth. Expansion of the town's population would necessitate more complete law enforcement services.

(5) Fire department

The volunteer fire department which provided an insurance services rating of seven, three years ago, has 18 men. Their equipment is old and needs replacing. The town has access to support equipment if needed and the water supply and pressure throughout the town are adequate. At present, the town is attempting to organize a fire district which would provide funds for new equipment.

(6) Health facilities

Medical facilities in Colstrip are limited at present. There is one first aid trailer located at the mine. Hospital facilities are located in Forsyth, and residents frequently go to Billings and Miles City for more complete health service.

Colstrip has two ambulances staffed by eight volunteers, most of whom have had Emergency Medical Training. The doctor in Forsyth is paid a retainer fee and emergency patients are generally taken there. The town has provided facilities for a dentist, and one has begun practice in Colstrip. A medical clinic which the Miles City Medical Clinic proposes to administer has been constructed in the Colstrip community center. It is expected that the Miles City Clinic will hire a doctor to staff the Colstrip facility.

b. Forsyth

(1) Housing

According to the Special Census conducted during January of 1976, (U.S. Department of Commerce, Census Bureau, 1976) there were 956 housing units in Forsyth and of these only 28 units were vacant. The distribution of units is estimated to be: 475 single-family, 60 apartments, 160 motel rooms and 248 mobile homes with the majority considered below average.

There is some new development occurring in the town. A 238-unit mobile home site has been proposed and there is also a property currently for sale on which a developer is proposing to build 32 units. Most of the development during the past five years, and that which is currently proposed, is for mobile homes. The town would like to promote growth of compact residential areas with good traffic circulation patterns.

In March, 1977, there were approximately 55 vacant units in Forsyth and the Colstrip vicinity (written communication, WECO, March 16, 1977).

(2) Water system

The City of Forsyth draws water from the Yellowstone River at a rate of 50 cubic feet per second which is adequate for almost 22,000 people. The water is stored in a 3,000,000 gallon reservoir which was just constructed last year. This has increased capacity to meet peak day demands and fire requirements.

The water treatment plant is in the process of being rebuilt, and will have a water capacity of 3,500,000 gpd. Average use during the summer is approximately 1,200,000 gpd, and the average for the year is about 480,000 gpd.

The distribution system is adequate and plans are being made to put in a new ten-inch main which will tie into the existing mains.

(3) Waste disposal

Forsyth has a lagoon system with two cells totaling approximately 7.75 surface acres. According to state design standards this is sufficient for a population of less than 800 people and an average of 80,000 gpd of sewage. The estimate of peak capacity of the lagoon is 250,000 gpd although it could not handle this amount on a daily basis.

Present usage ranges from 340,000 gpd to 408,000 gpd for an average day and the system is definitely beyond its capacity level. The effluent discharge does not meet state health standards and can no longer be discharged into the river. The collection system is also in need of repairs.

Forsyth has \$150,000 budgeted for improvements to the system and an engineering firm has been contracted to complete a study. The town is also attempting to buy land for a third lagoon but has not been successful in obtaining title.

(4) Police department

Law enforcement is consolidated into the city-county concept and is administered by the Sheriff's office. These officers have jurisdiction over all the area in the county. There are some problems in raising sufficient funds for man-power and equipment. The county is levying the maximum amount to generate income and this is supplemented by various federal funds.

In addition to the sheriff's department, two highway patrolmen under district supervision from Miles City also cover Rosebud County, and two fish and game wardens can be called on in emergencies. The justices of the peace are very busy with only one full time located at the county seat. The other is located at Ashland and holds court one night per week or as needed. Altogether the law enforcement system in Rosebud County is made up of the following personnel:

District Judge, Court Reporter, Law Clerk-----	(3)
Sheriff and Undersheriff-----	(2)
Deputies: -----	(13)
Forsyth-----	(6)
Colstrip-----	(3)
Ashland-----	(2)
Rosebud-----	(1)
Birney-----	(1)
Special Deputies-----	(21)
Jailers-----	(6)
Full time-----	(4)
Part time-----	(2)
Civil Defense Director (Also Jailer)-----	(1)
Livestock Inspector-----	(1)
E.O.C. Dispatchers-----	(8)
Full time-----	(3)
Part time-----	(5)
Secretary-----	(1)
Highway Patrol-----	(2)
Juvenile Officer-----	(1)
Adult Probation Officer-----	(1)
Secretary - Serves both-----	(1)
County Attorney-----	(1)
Deputy County Attorney-----	(1)
Secretaries-----	(2)
Justice of the Peace-----	(2)

The major problems which are encountered regularly are family quarrels and complaints, bar fights, robberies, and serving civil papers. The officers feel that the amount of major crime will increase as a result of large influxes of new people. In addition, traffic problems are compounded and civil suits, insurance claims, and highway fatalities increase (Rosebud County Planning Borad, 1977).

Recruiting, training and retaining good personnel is another problem since wages paid in energy-related jobs draw most of the labor supply. These developments are also the major reason for expansion of law enforcement services. As individual towns grow they may be able to provide for their own police protection.

(5) Fire department

Forsyth is served by a volunteer fire department with 16 men and has a class 7 rating. Equipment is old but provides sufficient fire

fighting capacity. With the completion of the new water plant, the water supply will be considered adequate for the city's needs. The new 3,000,000 gallon storage tank with the old 30,000 gallon storage tank has also improved the fire fighting capacities. With the water plant completed, the town will be eligible for a new class rating. It has been recommended that the town be able to maintain a 2,500-3,500 gpm fire flow for a ten-hour period.

(6) Health facilities and services

The Rosebud County Hospital, built in 1973, is a complete and modern medical facility serving Rosebud and Treasure Counties. A nursing home adjacent to the hospital was built in 1957 and is in fairly good condition. With 26 beds in the hospital and 39 beds in the nursing home, the hospital had 2,980 in-patient days and 2,283 out-patient days from June, 1974 to June, 1975. Eight beds were transferred to the nursing home in 1975, and the hospital is now certified for 18 beds and nursing home for 47. The nursing home has 45 semi-permanent patients.

The hospital staff is comprised of two doctors and ten RN's, most of whom are part-time. There are three consultants, a pathologist, a radiologist, and a physical therapist, who come to Forsyth once a month and are on call at all times. In addition to this staff, there are two RN's and seven LPN's who work in both the hospital and nursing home, and two RN's who work only in the nursing home.

The doctor shortage at Forsyth has severely restricted the utility of the hospital, and many potential patients go to Billings, Miles City, or other regional hospitals. The town has tried to acquire a new doctor for many years but has so far been unsuccessful. It seems many doctors are either looking for a quiet town to retire in and do not want the Forsyth workload or are young and want the urban environment.

Rosebud County maintains an ambulance service that has one full-time employee and, at present, three volunteer drivers from the sheriff's office. This number is low and they generally try to have six volunteer drivers available. Only one driver has had Emergency Medical Training, the rest have had First Aid Training. An RN assists on ambulance calls.

There are two state qualified ambulances; a 1971 model and a 1976 model - both fully equipped including police radio. In addition to the county ambulances, there are two qualified ambulances at Colstrip, one owned by Western Energy and the other by Bechtel Corporation.

One dentist practices in Forsyth.

The Public Health Nurse in Forsyth serves the county's estimated 10,000 residents, and the major services provided are immunizations and screenings for school children. Clinics are held for immunizations, schloresis, multi-face screenings, hearing and vision screenings, and diabetic screenings. Home visits are provided by the service. The nurse has an active case loan of approximately 100 people per month. Generally, the office is staffed by one RN, although, occasionally there are student nurses or volunteers to assist with the work.

The mental health service in Miles City maintains an office in Forsyth staffed by a psychologist two days a week.

c. Lame Deer

(1) Housing

Little data exists concerning the housing situation in the town of Lame Deer. However, it is believed that 200 units of new housing is currently needed on the Northern Cheyenne reservation. These will be in addition to 400 units of mutual help and 74 units of elderly housing which is projected. Total HUD public housing on the reservation will be 584 units primarily located on rural sites.

(2) Water system

The Northern Cheyenne Utilities Commission, in cooperation with the Bureau of Indian Affairs (BIA), manages all utilities on the reservation. Water from three relatively shallow wells, each producing 45 gpm, provides a sufficient flow of water to adequately serve the town's population. There is concern about the possible effect of strip mining on the water flow. Also needed would be another well and pump as a high school was built in the area. The reservoir has a storage capacity of 400,000 gallons, which is just sufficient to meet current demand.

(3) Waste disposal

Sewage needs are handled by a ten-acre lagoon. Solid waste is disposed of in a land fill dump which is open to the public and maintained by the Indian Action Team. Lame Deer residents contract with a private collection service.

(4) Police department

An 11-member tribal police force stationed in Lame Deer has responsibility for the entire reservation. Jurisdiction is restricted to Indian people although non-Indians may be detained until transferral to authorized county law enforcement officials. Equipment and service appear to be adequate to meet present needs.

(5) Fire department

The Lame Deer Fire Department is a 20-member volunteer organization with old and inadequate equipment to provide sufficient fire protection. The department has a truck with a 250 gallon tank and a tank truck with a 1,500 gallon capacity but no pumping capability. The Forest Service provides assistance with any forest and grass fires on the reservation.

(6) Health services

The Indian Health Service operates an out-patient clinic, staffed

by 3 nurses, 2 physicians and 1 assistant. Hospital patients must be transferred to the Indian Health Service Hospital at Crow Agency. The construction of a new clinic in Lane Deer is being discussed with a pending request for federal funds.

A psychiatric nurse works with the Mental Health Official in the Indian Health Service Clinic. However, a general increase in the number of trained Indian counselors would be helpful.

Welfare assistance is provided by a field office in Lane Deer. The staff currently employed is adequate but increased demand for services expected with population growth will necessitate an expanded operation.

d. Ashland

(1) Housing

Housing in Ashland is in critically short supply. No available housing, including trailer houses, is known to exist. Plans to subdivide on present agricultural lands are being discussed to relieve some of the impact due to energy-related development.

(2) Water system, sewer system, solid waste disposal

The city of Ashland has just completed a new water system designed to handle the increased demands caused by population growth. The water treatment facility will have the capacity to treat 360,000 gallons per day and a distribution capacity of 720,000 gallons per day. The sewer treatment facility will be able to treat 450,000 gallons per day. The system will use one pump for the sewage treatment center and if it is necessary to increase capacity, more pumps can be added. These two systems are expected by the project engineers to handle the water and sewage demands until 1985.

(3) Health facilities

There is a health clinic in Ashland established through funding of the Old West Regional Commission. The funding is primarily for setting

up the clinic with equipment and supplies and after 16 months the clinic must be self-supporting. Although it is a nonprofit organization, expenses for doctor, nurse and overhead must be met through operating revenue.

(4) Police department

Ashland's law enforcement service is provided by the county sheriff's department. There is some discussion with regard to the city providing its own services but nothing definite has been planned.

e. County services

(1) School districts

Rosebud County has nine school districts which include eight public elementary schools, one middle school and three senior high schools. In addition, there is a private elementary and high school in Ashland. At present, three school districts are ready to begin construction of new facilities, and one district has already begun construction.

A summary of facilities and enrollment is present in table 33 and a more detailed description of each district can be found in Appendix E.

(2) Sheriff's department

City and county law enforcement is consolidated and is administered by the Sheriff's office. The Sheriff's Department serves all the towns and rural areas of the county, except for the Northern Cheyenne Reservation, an area of 5,037 square miles with a population of approximately 9,000 people.

The Department is staffed by the sheriff, an undersheriff, and 13 deputies and has nine patrol cars, all of which are 1974 and 1975 models and in good condition. The men and equipment are stationed throughout the county with the sheriff, undersheriff, six deputies, and six patrol cars at Forsyth; three deputies and two patrol cars at Colstrip; two

Table 33. -- Summary data for school districts - Rosebud County

<u>District</u>	<u>Community</u>	<u>Grades</u>	<u>Enrollment</u>	<u>Estimated Capacity</u>	<u>Teachers & Staff</u>	<u>Condition</u>
2	Angela	1-5	6	12-15	1	Good
3	Birney	1-8	12	26	2	Good
4	Forsyth	K-6	349	700-800	73	Good
4	Forsyth	7-8	105			Adequate
4	Forsyth	9-12	231			Adequate
6	Lame Deer	K-8	415		24	Good
11	Colstrip	K-8	310	400	43*	Good
12	Rosebud	K-12	168	200	15	Excellent
19	Colstrip	9-12	287	300		Good
325	Ashland	K-8	92	200	10	Good
33	Ingomar	K-8	25	32	4	Adequate

*Including high school teachers

deputies and two patrol cars at Ashland; one deputy and a patrol car at Birney; and one deputy and one car at Rosebud.

There is an office in Forsyth with approximately 1,000 square feet of space and one in Colstrip with about 525 square feet; the men in Ashland, Rosebud and Birney work out of their homes. There is one jail in the county which was built in 1904 and is located in Forsyth. Housed in the town hall, the jail is in poor condition and should be replaced as it does not have sufficient space, private attorney-client rooms, or adequate cooking facilities. The jail will hold a maximum of 12 people and is staffed by seven jailers who keep a 24-hour watch on a rotating schedule. The sheriff feels the department needs a new modern jail that will meet state requirements and tentative plans have been made for a facility that would accommodate 40 people; that will not only meet the present needs but also the county's projected population. The sheriff would like to see a second jail constructed at Colstrip, a community larger than Forsyth and one with a higher arrest rate. The sheriff has requested two more men, although ideally, he would like three or four more and another car. The department also needs an office in Ashland.

It is felt that towns such as Colstrip and Ashland will have to incorporate and form their own police departments. Other communities in the area may also require full time deputies.

(3) Rural fire department

Rosebud County is served by a volunteer department operated by the Sheriff's office with assistance from a crew of three from the county shops. Fire fighting equipment consists of three spray trucks owned by the County Weed Board, two 6 x 5 army surplus trucks, and standard small equipment. The three spray trucks have 250-gallon tanks with low pressure pumpers of approximately 25 gpm capability. In case of fire, the spray

trucks must be called in, have the insecticide drained, the tanks refilled with water, and be driven to the site. The two 6 x 5 trucks are stationed on ranches in the southern part of the county where most fires occur. These two trucks have 1,200 gallon tanks and pumpers with approximately 50 gpm pumping capability. In addition, the nine patrol cars, which can respond immediately, are all equipped with small backpack tank-pumper units for fighting fires. Many ranchers in the county also have some equipment--generally 100-gallon water tanks with pumping equipment.

No plans have been made for the expansion of the county's fire fighting capability; although, due to the area's growth, the sheriff would like to see rural fire protection set up as a separate department with its own fire chief.

(4) County health services

Other health facilities provided by Rosebud County include services for mental health, and alcohol and drug abuse. The county is included in the 17-county area served by the Eastern Montana Region 1, Mental Health Center. The main office for the Center is located in Miles City, and complete mental health attention is provided by the staff there, including psychiatric consultation and assistance, counseling and diagnostic services for both in-hospital patients and outpatients.

A clinical psychologist and a social worker are located in the Ashland area to serve the southern part of Rosebud County. A counseling psychologist is also located in Forsyth to provide individual, marriage and family counseling to the Forsyth, Rosebud, Colstrip, and the northern county area.

Consultation services and workshops are available locally to schools, hospitals and other agencies on request. A mental health nurse has recently started traveling regularly to Rosebud County to make home

visits to patients regarding medications and to help provide support and understanding in the home situation.

In 1974, Rosebud County became the first county in the State to formally adopt an alcohol and drug program as a part of the Public Health Department. This program was instituted as a result of a joint effort on the part of the Rosebud County Commissioners and the State Alcohol Services Division of the Health and Environmental Sciences Department. Funding of the program was assured for 12 months through a grant in aid appropriation of two-thirds of the total budget expense with Rosebud County providing one-third matching funds.

Initial program priorities place emphasis on education, and awareness of potential alcohol and other drug dangers with school age people as the principal target group. Individual and family counseling services are available to all residents of the county who are experiencing difficulties as a result of drug-related abuse as well as information and referral services.

(5) Communications facilities

Rosebud County is served by the Forsyth Independent and the daily Billings Gazette. A 5000-watt radio station is located in Forsyth and three additional stations can be received in the county. Community T.V. provides six television channels.

(6) Library facilities

The library in Forsyth serves the Rosebud County residents and was built in 1970-1971. The main floor houses a reading room, book and periodical collections, and the librarian's office. Two community rooms and a kitchen with facilities to accommodate 100 people are located in

the basement. The book collection includes 20,000 volumes and can accommodate 10,000 more.^{1/}

^{1/} Community facility data from Environmental Baseline Studies for Crow Indian Coal Leases, Socio-Economic Report by Mountain West Research, Inc.; December 19, 1975, and Rosebud County Comprehensive Plan, unpublished data, Cumin Associates, Billings, Montana; March, 1977.

7. Transportation

a. Railroads

Railroad service in Rosebud County is provided by both the Burlington-Northern and Milwaukee Railroads. This service consists of freight, sugar beets, clay and coal unit train shipment. Passenger train service is provided to Forsyth by the Amtrak System. East-bound traffic makes one scheduled stop on Tuesdays, Thursdays and Saturdays, and west-bound traffic makes one scheduled stop on Tuesdays, Thursdays, and Sundays. On June 15, 1977, Amtrak will provide daily stops in Forsyth for the summer.

The Burlington-Northern added 51 coal-related jobs between 1971 and 1976 in Rosebud County. Additional yard track was added in the Forsyth yard and a passing track was completed between Colstrip and Forsyth between 1975 and 1976. A coal loop loading system has been installed at WECO's Rosebud Mine near Colstrip to speed up coal loading. A Central Traffic Control System was installed in Hysham, which completes a 147.5 track route mile unit which operates out of Glendive. A project to relay 14.5 miles of continuous welded rail was begun in 1976 but it is not yet completed. A project will begin in 1977 to rebuild three bridges at Nickels; two of these bridges will have walks and railings and one will have ballast decking.

The Milwaukee Road serves the northern part of the county including the communities of Sumatra, Igamar, Vananda, Forsyth and Cartersville. At present the Milwaukee Road is trucking coal to Forsyth and loading it on trains for shipment; it also moves clay for Hallett Minerals in Vananda and carries this to Minnesota. It appears that improvements will need to be made on the track and upgrading is planned for the future.

Coal from the WECO's Rosebud mine is loaded onto trucks and transported about three miles to a primary and secondary crusher. The coal may then be placed on railroad cars for shipment. Unit trains carry coal from Area A to Wisconsin Power and Light and Upper Peninsula Power in Wisconsin; and Northern States Power and Great Lakes Coal and Dock Company in Minnesota; Area E coal also goes to the Billings plant and to Colstrip generating units one and two (oral communication, Martin White, Colstrip project manager).

b. Buses

Bus service to Forsyth is provided by Greyhound Bus Lines. Two scheduled stops for east-bound traffic, and three scheduled stops for west-bound traffic are made daily. Rosebud remains a "flag-stop"--if there are arrivals or departures, the bus will stop. There are no ticket sales in Rosebud.

c. Motor freight

Motor freight services are provided to the county by Garrett Freightlines, Salt Creek Freightways, Burlington-Northern, Ashland-Harlo, and Molerway Freightlines. Garrett Freightlines maintains a dock in Forsyth with a private commission agent to handle the freight. Salt Creek Freightways handles only inter-state freight for the county. Inter-state freight is handled for Salt Creek by Hart Motor Express; an agent is employed in Forsyth and works out of his home. The freight is dropped at Forsyth, and the agent makes the deliveries. Any freight destined for Birney first goes to Sheridan, Wyoming, and then is delivered to Birney. Ashland-Harlo Freightlines makes direct deliveries to all areas in Rosebud County except in Colstrip. Burlington-Northern provides inter-state service as needed in Forsyth with the area office in Miles City. Molerway Freightlines makes freight deliveries to Ingamar, Sumatra and Vananda with the daily mail run.

d. Airports

There are two airfields within Rosebud County, Tillit Field in Forsyth and the St. Labre Mission Airport near Ashland.

The St. Labre Mission Airport is a privately owned air field with four based aircraft. It handles air-taxi operations but offers no flight services at the airport. There is one gravel surfaced runway, 3575 feet long by 100 feet wide (13-31). Approach to the landing strip is tree obstructed. There is a clear and green beacon light, taxi-way lights, wind indicator, but no landing lights.

Tillit Field is a county owned airport. In 1972 the Rosebud County Commissioners funded a complete airport master plan. Since the completion of this master plan, much work has been done to the field. The primary runway (8-26) has been constructed and is 75 feet wide by 4800 feet long. A secondary crosswing runway (11-29), recommended in the master plan, has not yet been constructed. Two taxi-ways (1250 feet by 40 feet) have been constructed as well as a general aviation apron. A new access road has been constructed to the new apron. Land acquisition of 185 acres, as recommended in the master plan, has not yet been undertaken. A boundary fence and runway lighting and navigational aids have been installed. A new hanger has been constructed which compliments the existing five hangers and houses a helicopter and two airplanes. As of now, no maintenance is provided at the airport.

A county shop is planned to be constructed on county land southwest of the airfield property. This will house snow removal and weed control facilities at the airport and full time manager and maintenance crew is planned for the future. An Airport Board advises the county on the airport. The County Commissioners, however, retain final budgetary, contractual, and administrative powers and appoint the airport manager.

Tillit Field receives financial support from a county permissive mill levy, private building and hanger leases, and miscellaneous income.^{1/}

e. Roadways

Rosebud County is connected by a transportation network ranging from dirt roads for local traffic to Interstate Highway 94 (I-94) serving local and out-of-state traffic. In 1975 high average daily traffic (ADT) entering Forsyth on I-94 was 3400; the ADT leaving Forsyth on I-94 for the same period was 3385. The next most heavily traveled road in the county is Federal Aid Secondary (FAS) Highway 315 between Forsyth and Colstrip. The 1975 high average ADT at the I-94 and FAS Highway 315 intersection was 288; at Colstrip mile post 18, the ADT was 1425; and at Colstrip mile post 25, the ADT was 893. Included in Appendix E is a table showing historic and currently available ADT count data for the county area around Colstrip (written communication, Northern Powder River Basin Environmental Impact Statement task force, March 17, 1977).

In the Rosebud Mine A and E mining areas, the existing haulage roads consist of graded and compacted shale from the mine surfaced with crushed clinker mined in the area. The roads are between 50 and 80 feet in width and are elevated to one to three feet above adjacent ground level to provide for good drainage and to minimize snow drifting. Actively used roads are maintained by a motor grader and culverts are provided wherever the access road crosses natural surface drainage channels. The mine haulage roads are designed for continuous use by heavy off-highway 100-ton bottom dump trucks that are used to carry the coal from the active mine pit.

^{1/} Rosebud County Comprehensive Plan, unpublished data, Cumin Associates, Billings, Montana, March 1977).

8. Recreation

There are no developed recreation facilities in the unmined portions of Areas A and E at Colstrip. It is conceivable, however, that some hunting, sightseeing and other dispersed forms of recreation could occur but there is no use data available to substantiate this. Because the land is all privately owned, the opportunities for general public use are limited.

a. General area

The proposed Mining Areas A and E at Colstrip lie within Planning Region 3 as established by the Montana Statewide Outdoor Recreation Plan (SCORP) (Montana State Fish and Game Commission 1973). The following discussion draws heavily from SCORP data; however, it should be noted that statistics for Region 3 are based on a very low number of responses and cannot be considered definitive. Also, the surveys were conducted in 1971-72 and may not indicate use patterns or preferences of any residents in the region. In their Statewide Outdoor Recreation Plan, the Montana State Fish and Game Commission (1973) reported:

" * * * Indoor spectator activities are the most popular use of leisure time by Region 3 residents. Outdoor recreation is second in popularity and is closely followed by home-related activities. * * * "

" * * * Region 3 residents prefer undeveloped natural environment areas by a slight margin over general outdoor recreation areas. The local forested areas are popular. Sites are chosen because they are close and/or a specific activity is available. Montana residents accounted for 78.6% of the recreation use in Region 3, and the majority of these users are Region 3 residents.

Recreation Resources: Since most of the use by Region 3 residents is on a day use basis, only the outdoor recreation resources available within a 50 mile radius of Colstrip will be discussed in detail. Similarly, the urban recreation resources discussion will be limited to Colstrip and Forsyth.

Outdoor Resources: Outdoor recreation resources are fairly numerous and varied within the day use area. Major attractions include Custer Battlefield National Monument; the Custer National Forest (Ashland Division); portions of the Tongue, Bighorn and Yellowstone Rivers; and a number of historical sites.

A wide variety of use opportunities are available. Some of the most valuable are hunting for deer, antelope, upland birds and waterfowl; warm water fishing; floating the rivers; collecting moss agates (local semi-precious stone); and visiting historical sites. No specific data is available for determining actual use of the recreation resources in this area.

Developed facilities include 28 camping units, 25 picnicking units, 1 swimming area, 1 boat ramp and 4 fishing access sites.

Urban Resources: The towns of Forsyth and Colstrip are the only urban areas within the day use area. Both contain a variety of athletic fields, play grounds, swimming areas, etc., which are considered generally adequate for the immediate and near future needs of the residents." (see table 34)

Table 34. -- Urban recreation facilities for Forsyth and Colstrip

<u>Facility</u>	<u>Forsyth</u>	<u>Colstrip</u>
Outdoor Ice Rink	3	1
Outdoor Track*	0	1
Football Fields*	1	1
Baseball Fields	1	2
Outdoor Basketball Course	1	0
Indoor Basketball Courts	1	1
Indoor Volleyball Courts	1	1
Golf Courses	1	0
Outdoor Tennis Courts	2	3
Outdoor Swimming Areas	1	1
Wading Pools	1	1
Meeting Rooms	Many	2
Tot Lots	0	2
Boating Facilities	1	1
Playgrounds*	4	4
Picnic Areas*	2	1
Rifle Range	1	1
Bowling Alley	1	0
Gymnasium	0	1
Craft Rooms	0	1
Handball - Paddle Ball Courts	0	2

*Under construction in Colstrip. Most of these facilities are to be included in a community building.

b. Colstrip Parks and Open Space System

Park and open space areas are provided within the townsite at Colstrip and on the southeast shore of the Surge Pond (fig. 20). The Parks and Open Space System includes 57 acres or just over 25% of the total 221-acre town site.

The Colstrip Parks and Open Space System is designed as an integral part of the function of the town of Colstrip. Of the 221-acre town area, 57.13 acres are designated for park and open space development. Figure 20 shows the park masterplan.

The Colstrip Parks and Open Space System including the Community Center are managed by the publicly elected Recreation Board (Colstrip Area Recreation and Parks Association) which employs two recreation directors. User fees have been set by the Board for use of the facilities in the Community Center and the swimming pool. WECO continues to assist the Recreation Board in financing the recreation program and is responsible for maintenance of the parks.

c. Surge Pond Recreation Area

The Surge Pond Recreation Area totals approximately 6 acres and is accessible off State 315 west of the High School. A 1200-foot service access road terminates at a 20-car parking area. Twelve picnic sites in a grove of ponderosa pine are provided, a sand beach area has been developed, gravel paths are provided and a scenic overlook is located on a bluff above the lake. Open areas for field sports are available and access for nonmotorized boating and fishing is provided.

The Surge Pond has been stocked by the State Fish and Game and will provide for fishing in coming years (see letter from Montana Fish and Game Department in Appendix E).

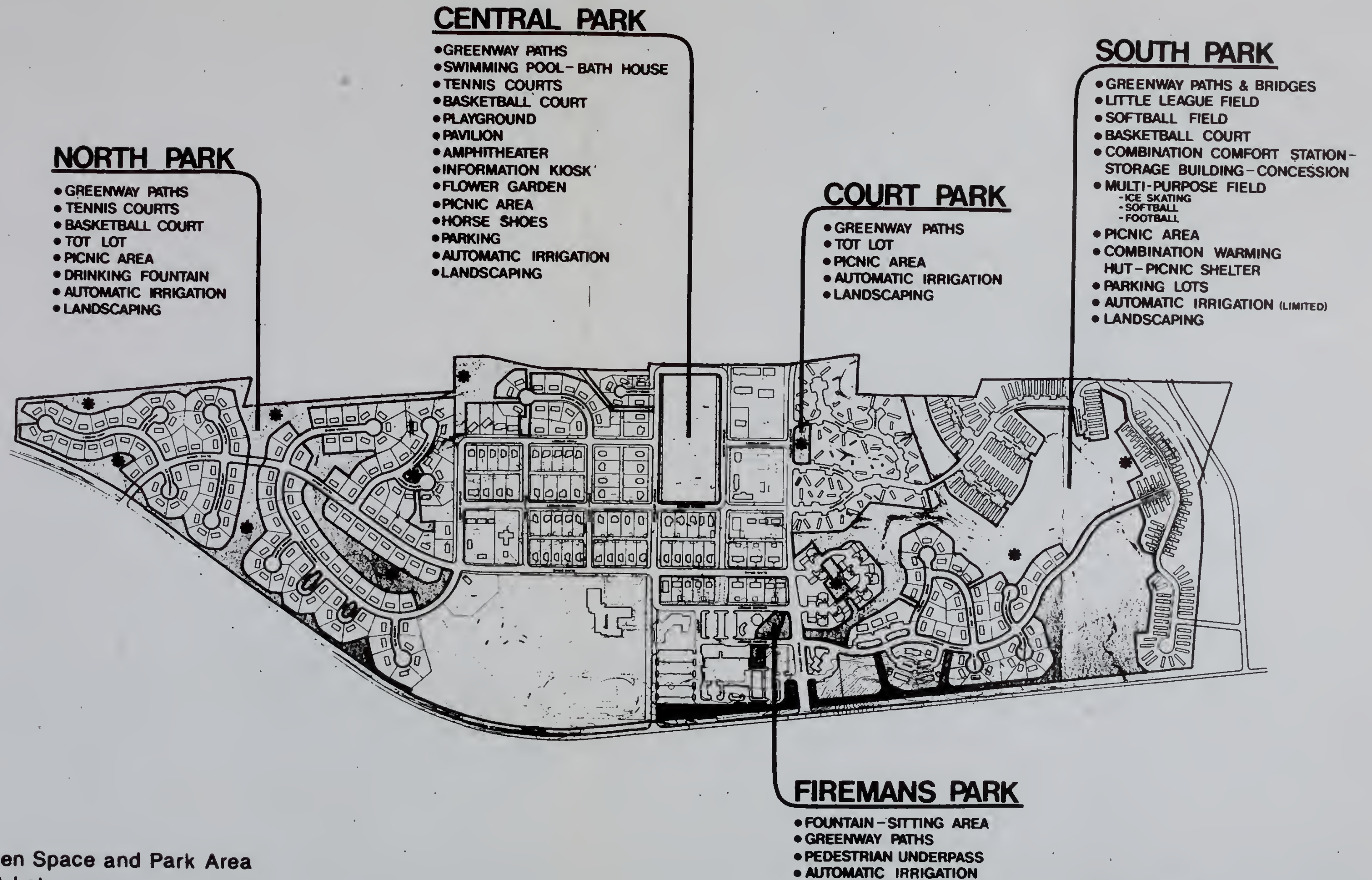


Figure 20

Master Plan

COLSTRIP PARK and OPEN SPACE SYSTEM

EXHIBIT 'D'

9. Archaeological and historical sites

a. Archaeological sites in Areas A and E

Archaeologists on the Northwestern Plains have had difficulty in categorizing sites since they initially started reporting them. Most authors try to classify sites by using functional criteria. Thus a bison drive site functioned for meat procurement and functional criteria are adequate to classify the sites. Other Northwestern Plains archaeological sites do not lend themselves to similar categorization. On numerous sites the only evidence of prehistoric man is the fragments of stone which are the result of manufacturing chipped stone tools. These fragments, labeled flakes or chips, are collectively referred to as lithic detritus, chipped stone debitage, or lithic debris.

In some instances the archaeologist may recover only four or five fragments of lithic detritus, while at other times several thousand flakes and dozens of recognized artifacts may be collected. In either case the debitage or artifacts are the only evidence of prehistoric use of the area. The problem for the archaeologist is at what point does he label a lithic detritus area as an archaeological site or how does he determine the function of such an area.

The usual approach of an archaeologist has been to avoid the problem and label all the areas as occupation sites. If house remains or suspected house remains were noted on the site it may be further categorized as a tipi ring site or an occupied cave site. Some attempts have also been made at classifying the sites where no house remains were evident. These sites may be labeled as lithic scattered areas, chipping stations, hunting lookouts and open terrace campsites, or they may simply be categorized as occupation sites, with no additional subdivision.

Larry A. Lahren (1977), under contract with the United States Geological Survey, searched the surface of Areas A and E, Western Energy Coal Lease, for archaeological and historical remains. Lahren completed the work in the Summer of 1976 and submitted a typescript copy of the results to the Montana Department of State Lands in 1977. The report conflicted somewhat with the earlier archaeological work in Areas A and E included in a report by Fredlund and Fredlund (1973). This is not surprising since as indicated above, different archaeologists tend to assign site numbers and label archaeological sites with different variables.

Lahren (1977) reported eighteen archaeological sites which will be affected by the coal mining. One site, WE-11, has been destroyed by mining since it was recorded in July, 1976. Thus, seventeen archaeological sites are in imminent danger of destruction.

All seventeen sites are lithic scattered areas. They are not a unique type of site on the Northwestern Plains nor are any of the sites very important. However, the cluster of lithic scattered areas in 1-41-4 indicates sufficient utilization to warrant further research.

Using the available site information that was supplied by Lahren (1977), the archaeological sites have been ranked according to their relative importance (table 35). The following categories have been used:

1. Critical - The location has rare or unique scientific value and/or relationships which make preservation or mitigative excavation mandatory. This category includes current National Register sites and sites which are recommended for National Register inclusion.
2. Major - The location has major scientific value, and testing and mitigative excavation is extremely important. Portions of the site may require preservation and if testing produces significant information the site may be moved to the critical category.
3. Moderate - The location has scientific value and should be tested; select portions may warrant salvage or preservation.
4. Minor - The location has minor scientific value and loss of the site would not be significant scientifically; surface salvage is desirable and may produce sufficient data to warrant limited testing.
5. Trivial - The scientific value of the location was recorded in the initial survey. Additional work would not produce more data.

Table 35. -- Archaeological site ranking for Areas A and E
Rosebud Mine, Big Horn County
 (From Lahren, 1977)

T.	R.	Sec.	Site Type	Ranking ^a	Site Number
<u>Area A</u>					
1N	41E	4	Open Terrace Camp	3	WE-26
1N	41E	4	Open Terrace Camp	4	WE-31
1N	41E	4	Open Terrace Camp	3	WE-33
1N	41E	4	Open Terrace Camp	4	WE-34
1N	41E	4	Open Terrace Camp	3	WE-36
1N	41E	4	Open Terrace Camp	4	WE-37
1N	41E	4	Open Terrace Camp	4	WE-38
1N	41E	4	Open Terrace Camp	4	WE-39
2N	41E	32	Ridgetop Occupation	4	WE-40
2N	41E	32	Ridgetop Occupation	4	WE-41
2N	41E	32	Ridgetop Occupation	3	WE-42
2N	41E	32	Ridgetop Occupation	4	WE-43
<u>Area E</u>					
1N	41E	2	Ridgetop Occupation	4	WE-9
1N	41E	2	Ridgetop Occupation	4	WE-10
1N	41E	12	Ridgetop Occupation	4	WE-7
1N	41E	12	Ridgetop Occupation	4	WE-8
1N	41E	12	Ridgetop Occupation	3	WE-25

^aRanking: 1=critical; 2=major; 3=moderate; 4=minor; 5=final;
 See accompanying text for further explanation

The criteria used in placing each site into a category was developed from the site data supplied by Lahren (1977). This data included observations on the amount and density of the lithic debris, the variety and number of artifacts collected, the presence or absence of faunal remains, the variety in the detritus (porcellanite, obsidian, chert, etc.), the presence or absence of features (hearths, storage pits, rock cairns, etc.), and the recommendation for additional research. Using a combination of these variables the sites were categorized and ranked (table 35).

b.) Historical data

An historical overview of the Armell Creek area was prepared by Joann Stephan in 1973. This report appeared in Fredlund and Fredlund (1974) and again in the Environmental Analysis - Western Energy Coal Lease Modification (1976). Archaeological portions of these studies are herein adopted by reference.

One historic homestead was recorded in an area which will be affected by the coal mining in Area A - Western Energy Coal Lease. This homestead was numbered WE-49 in Lahren (1977) but little more than the location (1-41-4) was described. Before destruction the homestead needs to be recorded through photography and documentation.

10. Aesthetics

a. Visual resources

Aesthetics, as used in this description, concern the overall appearance of landscape as perceived through the senses of sight, sound, smell, taste, and touch. The visual environment accounts for a substantial portion of the perceived environment, thus major emphasis will be placed on the visual resources.

In general, the landscape is perceived as the interaction of topographic relief, geologic formations, vegetational coverage, water features and the influences of man-made structures and assorted land uses. The relative visual dominance or importance of various natural features changes from region to region depending upon such factors as geologic processes and climatic conditions. Physiographically, the Colstrip Area consists primarily of rolling hills, dissected plateaus and valleys. From a visual perspective, the vast majority of the land at Colstrip appears as a continuous mass characterized by subtle contour changes and open space, rather than by distinctly separate land forms. Within the Rosebud Mining Areas A and E and adjacent lands, the visually perceived characteristics are largely a function of the drainage networks, vegetational coverage, sandstone outcroppings and areas of steep terrain and related valleys.

In addition to these natural features, various types of land uses and structures are found within and adjacent to the mining areas. These land use features can have a positive, negative or neutral visual influence on the adjacent landscape depending upon their visual compatibility with the natural landscape demands and the integrity of the setting. Generally, positive influences are created by structures having distinct cultural or architectural integrity while negative, scenic influences are related to such uses as industrial facilities and utility corridors.

An inventory of scenic resources was accomplished by systematically identifying and mapping the dominant visual features of the landscape within and adjacent to Mining Areas A and E. The inventory was conducted from ground reconnaissance and aerial photo interpretation.^{1/}

^{1/} Slope and drainage information came from analysis of U.S.G.S. 1:24,000 topographic maps. Sandstone outcroppings, agricultural lands, reclaimed land, vegetation and mined areas were taken from recent airphotos taken by SCS Engineers, Billings, Montana, dated December 1976 and July 1974.

The dominant visual landscape is classified within the following categories:

- Steep slopes (30% and above)
- Sandstone outcroppings
- Lake (surge pond)
- Vegetation:
 - Ponderosa Pine
 - Grasslands
 - Agriculture
 - Riparian

Visual Modifications

- Rosebud Mines
- Reclaimed lands
- Railroad
- Transmission lines
- Developed town site
- Associated mining and power plant activities
- Temporary trailer court
- Power plants

The perceptual characteristics of these features are described in the following narrative. For greater understanding of the visual character of the Colstrip Area refer to the Visual Resources Map which shows the location and distribution of each of the features in relationship to the proposed mining of coal in Areas A and E.

Steep Slopes: Steep slope areas, defined for this study as those areas possessing a 30 percent and above slope gradient, were identified from the U.S.G.S. topo map. Based upon field reconnaissance, it was determined that these areas characterize visually distinctive

hill and ridge features. The majority of these areas line valleys formed by major drainages, such as East Fork Armells Creek. Mining Area A contains a significantly greater amount of land having greater than 30 percent slope than Mining Area E. In addition to their distinctive terrain features, many of the steep slope areas are characterized by exposed red, pink or white colored soils as a result of erosional processes. This type of landscape is most prevalent in the outcroppings and "red rocks" area located in the northern portion of Mining Area A. (Vegetation cover, where it occurs on the steep slope areas, is usually Ponderosa Pine found in scattered patterns.)

Sandstone Outcroppings: Numerous sandstone outcroppings are found within Mining Area A and Mining Area E. These geologic formations occur both along the sides and tops of steep ridges and on the valley floors and upper plateaus. The sandstone outcroppings are predominantly yellow to tan in color and often create visually striking formations which contrast with the surrounding vegetation, soils and topography.

Drainage Areas: Although there are no perennial water sources within the Mining Areas A and E, the drainages and creeks have a significant influence on the visual character of the landscape. The visual effects of these drainages and creeks are evidenced by the valleys and small canyons they have carved as well as the sources of moisture they provide to riparian vegetation growing along their banks. The most predominant creek is Armells Creek, which forms the southern boundary of Mining Area A (see fig. 3). These intermittent drainages are located in wide, steep-walled

valleys and follow a meandering path that is visually defined by green ash and cottonwoods as well as other riparian vegetation. There are a number of drainages throughout both Mining Areas generally characterized by low growing shrubery.

Lake: The surge pond located on the northeast boundary of Mining Area A is a rare landscape element in the semi-arid climate of southeastern Montana. The water in this 200-acre lake is used for Power Plants I and II and the town domestic system and will also serve for both recreational and as a major visual feature for the residents of Colstrip.

Vegetation: Vegetation cover constitutes a primary portion of the perceived landscape in this area, forming a variety of textures, patterns and colors. The plant communities within Mining Areas A and E and the surrounding areas were divided into the following classifications based upon their distinctive visual properties: riparian communities, ponderosa pine, grassland and agriculture.

Riparian: As discussed previously, riparian vegetation grows along many of the drainage areas. Perceptually, these communities consist of trees, shrubs and grasses which visually combine to form varieties of colors and textures in the landscape. Dominant and subdominant vegetation included as riparian are green ash, box elder, wild plum, chokecherry, prairie rose and snowberry. As a result of the proximity of this association of plants to meandering creeks and drainages distinct patterns, frequently contrasting with flatter surrounding grasslands, often emerge. As shown on the Scenic Resources Map the majority of this riparian vegetation is found in the East Fork Armells Creek.

Ponderosa Pine: Ponderosa Pine is a visually dominant vegetation type within the Mining Areas. More densely forested areas generally follow drainages and ridges and are scattered along hilltops forming visual features and patterns contrasting in texture and color with the grasslands. Ponderosa pine is found throughout both mining areas and covers approximately 25 percent of Mining Area A and 15 percent of Mining Area E.

Grasslands: Grasslands provide a generally homogeneous, smooth textured vegetation cover. Although a variety of grassland subtypes are found on the areas, color variations are subtle ranging in hues from light yellow to greens or tans, depending upon the time of year and dominant grass species. Perceptually, one of the most dominant features of the grasslands is the open view of the surrounding landscape that exists where topography permits.

Grassland is found predominantly throughout Mining Areas A and E and covers approximately 60 percent of Mining Area A and 65 percent of Mining Area E.

Agriculture: Scattered fields of dry cropland are located in the southern portion of Mining Area A along the bottomland of Armells Creek. Depending upon the time of year, these fields, used primarily for the cultivation of alfalfa and wheat, create distinctly shaped areas differing in texture and color with the surrounding grasslands, shrubs and trees.

b. Visual modifications

Visual modifications to the landscape that contrast with the natural scenery of Mining Areas A and E and surrounding area include Rosebud Mine, reclaimed lands, railroads, transmission lines, active

areas of the developed town site, temporary trailer courts, and power plants and associated mining and power plant activity.

Because of the physical alterations to the land required by these types of visual modifications, the natural integrity of the visual landscape at the future mining areas within Area A and E are reduced in value.

c. Summary

The visual landscape associated with the unmined portions of Areas A and E can be described as aesthetically pleasing. The primary landscape features dictating the scenic character of the area are steep sloping terrain with exposed colored soils, sandstone outcroppings occurring on hill ridges and along valley floors, scattered ponderosa pine that follow numerous ridges and slopes, riparian vegetation creating interesting patterns and textures along meandering creeks and drainages, open grasslands.

The steep sloping terrain, sandstone outcroppings and drainage create natural form, the exposed soils, sandstone, ponderosa pine and riparian vegetation contrast sharply in color and texture and visually dominate over the consistently flower expanses of grasslands. The agricultural areas stand out because of the rigid visual character of hue and color contrast associated with these areas.

The visual amenities associated with this type of landscape typifies large portions of eastern Montana. Lands surrounding Areas A and E contain similar and often times more striking visual features. Greater terrain variety, expressed by both higher elevation and definition of form, denser stands of ponderosa pine, more profuse rock outcroppings

and brilliant stratified soil colors are the major elements giving other similar but more distinct scenic amenities. In comparison, Areas A and E are neither unique or significantly representative of the scenery associated with this portion of eastern Montana.

In comparison to other landscapes with a one-day travel zone, (Appendix E), the future Mining Areas A and E represent neither the most scenic nor least scenic of landscapes. Comparatively, landscapes of far greater scenic value are found in the Bighorn Mountains, the Beartooth Mountains, the Pryor Mountains and the Bighorn Canyon. Many of these areas have been given special recreational or protective status due to their outstanding natural and scenic amenities. The various rivers passing through the region also often constitute high scenic corridors, depending upon the type and degree of land use development which has occurred. In addition, smaller mountain ranges to the northwest, east and southeast of the tracts, including the Bull, Rosebud, Spray, Wolf and Little Wolf Mountains, contain similar, but more visually striking landscapes than do Areas A and E.

There are also vast areas of land having less scenic interest than Areas A and E. Much of the land, characterized by similar dissected plateaus and valleys does not support ponderosa pine nor contain sandstone outcroppings or noticeable differences in soil colors.

III. Environmental impacts

A. Physical environment

1. Air quality

Continuation of surface mining in Areas A and E would result in loading essentially the same levels of fugitive dust to the air as are being experienced during current mining in these areas. The main sources of fugitive dust are unpaved roads, coal preparation and handling, and overburden removal. Gaseous emissions would contribute to degradation of the local air quality but these sources should be of minor significance.

In general, dust loading that results from traffic on unpaved mine haul and access roads would be at a minimum during late winter and spring because of ground cover conditions, i.e., snow, ice, frozen soil, etc. During the remainder of the year, particularly in late summer and early fall, dry and dusty roadway conditions prevail. Such conditions are conducive to relatively high particulate loading rates.

In the early 1970's the U.S. Environmental Protection Agency (U.S. EPA) conducted a study which included the investigation of particulate loading due to a study which included the investigation of particulate loading due to travel on unpaved roads (U.S. Environmental Protection Agency, 1973). This study concluded that the effect of vehicular travel on dust loading to the atmosphere amounts to 5-10 lb/vehicle-mile for standard vehicles, assuming a vehicular speed of 30 miles per hour. It was empirically determined that, on the average, 58 percent of the particulate loading from unpaved roads was due to vehicle dust plumes and 42 percent was due to wind erosion. For larger and/or multi-wheeled vehicles (e.g., haul trucks) the impact of vehicular traffic under the same conditions would be greater.

The large majority of fugitive dust created as result of mining activities would settle out within a relatively short distance of its source. Based on results of recent studies, approximately 80 percent of the fugitive dust created by tracked vehicles settles out within a few hundred yards of its source (Viletto and Ohman, 1972). For dust particles less than 2 microns in diameter travel distance is much greater and they may be carried by air currents for several miles or further.

In the mining process some particulate loading to the atmosphere would result from the removal and transport of overburden material. Estimates of quantities are not available at this time. Stockpiles of overburden material are also susceptible to wind erosion, with a consequent impact on particulate levels. General particulate loading data related to this type of material storage is presented in table 36.

According to mining requirements, no more than two spoil ridges behind the pit being worked would be left ungraded. The spoils are reduced to a 5:1 slope and are covered with topsoil as conditions allow.

Table 36.-- Uncontrolled fugitive dust emissions
(lb/year/ton) in storage pile^a
(From U.S. EPA, 1973)

<u>Aggregate</u>	<u>Fugitive Dust</u> <u>(lb/year/ton)</u>
Fine sand)-- Fill material)	10
Crushed rock) Gravel)-- Coarse sand)	1.5

^a

Based on the average weight of pile.
Source: U.S. EPA, 1973

In addition, fugitive dust would be generated during mining activities such as blasting, coal preparation, coal loading and transportation, stockpiling and reclamation, etc. It should also be recognized that the rate of dust loading to the atmosphere as a result of these activities is highly variable and dependent on such criteria as soil type, moisture content, wind speed and direction, and length of material exposure (which in turn affect revegetating capabilities) and others.

Current mining activity in Areas A and E is at a level that is expected to remain constant during the proposed expansion, hence, it is expected that cumulative impacts beyond existing conditions due to expanded mining will be minimal. Based on data from several of the particulate monitoring stations that are adjacent to current mining activity, particulate concentrations are generally below standards. At some of these stations, however, data indicate that concentrations appear to be marginal, and standards may be exceeded in the mine area with additional activity beyond present levels.

The coal energy development at Colstrip has resulted in substantial activity in the town which in turn has contributed significantly to dust loading of the local atmosphere and increased particulate concentrations to where levels are above state and federal standards. The main activities causing this impact are believed to be vehicular traffic (many roads in the town are unpaved) and construction of residences. Contribution of particulates from mining in Areas A and E are probably minor, except during high winds that are in line with one of the mine areas and the town. The present levels of fugitive dust are expected to be maintained until the local roads become paved or oiled and/or construction activity significantly decreases.

The most immediate and noticeable effect of dust loading would be the impairment of vision of objects at far distances. This could be the result of either discrete dust plumes or numerous dispersed, yet suspended, particles. Other results would be the deposition of particles on local foliage, man-made structures and possibly respiratory effects in humans and animals.

Besides particulate loading, emissions from gasoline and diesel powered mining equipment and vehicles will contribute somewhat to impacts on the local air quality. Average emission rates of sulfur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO) and hydrocarbons (HC) from heavy-duty construction vehicles, as determined by the U.S. EPA are presented in Appendix A. From these data it is estimated that even if all of the vehicles presented in the mining plan were in simultaneous operation, the total vehicular emissions would have an insignificant impact on the air quality of the local vicinity due to the large area within which the vehicles would be operating.

In summary, there is not expected to be a substantial decrease in air quality of the local area provided the level of mining activity does not significantly increase over present levels. After mining operations have ceased and reclamation has been completed, it is expected that the only impact on the air quality resulting from previous operations will be insignificant particulate loading from wind erosion effects on roadways and similar areas used for vehicular activity.

2. Geology

Implementation of the proposed mining plans would result in surface and subsoil disturbances. The amount of land to be disturbed over

the life of the mine plan in Areas A and E according to the permit applications is as follows:

<u>Type of Disturbance</u>	<u>Area A</u>	<u>Area E</u>
Mine Level	578	606
Associated Disturbance (Haul roads, rail, shop, topsoil storage)	78	582

Of the 606 acres proposed for permitting at the mine level in Area E, about 195 acres consist of old (orphan) spoils, some of which will be redisturbed under this application. Rosebud coal occurs and would be mined beneath 411 acres of Mine Area E.

In the area to be mined, existing topographic features and land surface would be destroyed. As mining progresses, mined land would be rehabilitated to a stable post-mining topography approximating the pre-existing land forms. Haul roads and associated disturbance areas would be reclaimed so as to not appreciably alter the topography of the original land surface.

As mining progresses, ground cover would be stripped of vegetation, topsoil removed and stored on the associated disturbance areas, and overburden removed and placed in spoil piles in mined out areas. Prior to reclamation and establishment of a vegetative cover, the potential for erosion would be greatly increased for these disturbed areas. The erosive effects of wind and rain would be significantly greater during this time and result in increased sediment transport. However, sediment retention ponds would be constructed to capture the majority of sediment load carried by surface water. These ponds would greatly mitigate and reduce the impact from any overflow on downstream reaches of the existing

drainage systems. The loss of soil as dust through wind erosion is largely unmitigable except for areas such as haul roads and reclaimed spoils where dust suppression techniques and revegetation can be effectively implemented.

The mining operation would destroy the physical continuity of the overburden in the mine pit and the cast spoils would have different characteristics. The existing ground-water regime will be destroyed in the mine pit and the resultant spoils material will probably have increased permeability, to both ground water and surface infiltration.

Upon mining, the spoils material at the WEC Co Rosebud mine would occupy an approximately 25 percent larger volume of area because of increased pore space. However, reclamation activities after mining would provide a large degree of compaction. It has been estimated by Tom Finch of the Montana Bureau of Mines and Geology that upon replacement of the overburden in spoil piles, up to 80 percent of the settling (compaction) would immediately take place. Rates of continued subsidence would gradually diminish with time. From available information, compaction of spoil materials is not expected to be a serious problem at WEC Co's Colstrip mine. More accurate predictions of compaction would likely be predicated on long-term monitoring of environmental conditions; but WEC Co does not plan to monitor compaction at its Colstrip mine because to date, it has not presented any problems.

Mining of the acreages involved would result in the removal of about 23 million tons and 16 million tons of Rosebud coal from Areas A and E, respectively. Approximately 1.1 and 0.8 million tons of coal will be left in the form of wedges and cleanings in the mine pits of Area A and E, respectively. About 0.2 million tons will also be left in Area E

because of the requirements for a buffer zone, pursuant to the Montana Strip Mined Coal Conservation Act. In addition, clinker and shale will be used in the construction and maintenance of access and haul roads for the project.

The McKay coal bed lies about 18 feet below the Rosebud coal in Mine Areas A and E and averages about 8.9 feet thick. All past production from WECO's mine has been from the Rosebud seam. The McKay coal would not be mined under the proposed action because there is not presently a market for this lower quality coal. It is an economic resource if one assumes this coal can be mined with the Rosebud. As proposed, approximately 10 million and 6 million tons of McKay coal would be left unmined beneath corresponding acreages of Mine Areas A and E.

3. Soils and overburden

a. Soils

As a result of implementing the proposed action, the natural soil profile would be destroyed and physical and chemical characteristics of the overburden in the areas designated for surface mining would be altered. In the associated disturbance areas of the mine, the upper few inches of the topsoil would be disturbed in many areas and the existing vegetation destroyed. Under the proposed mining plan the acreages that will be affected in these manners for Mine Areas A and E include 578 and 606 acres at the mining level, respectively, and 78 and 582 acres at the associated disturbance level, respectively.

To prevent destruction and loss of topsoil covering the proposed mine areas, topsoil would be removed separately from the overburden and saved for later redistribution on the spoils material. It is DSL's practice to prescribe depths of salvage, based upon sampling and analysis

data supplied by the applicant. Topsoil salvage would include removal and storage of the A (and sometimes B) horizon(s) separately from the B and C horizons. (WECo is presently using this method of topsoil salvage at all of their mining areas at the Rosebud Mine.) Following regrading of mine spoils, the mixed B and C topsoil material followed by a layer of A horizon material would be redistributed on the surface as the primary plant growth medium. Using this method of topsoiling with A horizon material, there is not expected to be any difficulties in revegetating mined areas to levels required by the state.

During the mining operation, affected acreage would be taken out of use by livestock until it has been successfully reclaimed. WECo estimates that it would take approximately 17 years and 8 years to complete all mining in Areas A and E, respectively, if unleased coal becomes available. Currently, Western Energy Company plans to mine about 3.7 million and 3.6 million tons of Rosebud coal per year from Mine Areas A and E, respectively. Based on an average of 41,800 tons of Rosebud coal beneath each acre, then approximately 90 acres and 85 acres of Area A and E, respectively, would be mined annually.

b. Overburden

The quality of the overburden in the proposed mine areas should not cause any significant adverse impacts on the environment following mining. Although both Areas A and E have localized strata with high concentrations of zinc, nickel and/or salts which may be potentially harmful if left near the surface, it is very unlikely as a result of the mining process that potentially toxic layers would be placed near the surface. In addition to the mining process, the sampling and analyses program required of reclaimed spoils would help mitigate the likelihood of such occurrences.

4. Hydrology

a. Surface water

(1) Primary impacts

Additional surface mining of coal in Areas A and E would destroy the existing surface drainage for these areas. However, reclamation of the mined area may restore it with a very similar drainage system.

The mining as proposed will not result in direct destruction of any springs or water reservoirs. If all additional land in Mine Areas A and E are mined, then 2 stock watering reservoirs on Mine Area A would be destroyed (figure 18 and table 37). In addition, 2 other reservoirs adjacent to Area A on the northwest and 1 spring a mile east of Area E may possibly have reduced storage or yield.

It is unlikely that the flow of water in East Fork Armells Creek or Cow Creek would be significantly altered as a result of the proposed mining activity. WECO does not intend to leave any permanent water impoundments as part of this proposed action unless research indicates that such a development is beneficial.

(2) Cumulative impacts

Cumulative surface water impacts as a result of mining in Areas A and E would be minimal. Removal of two stock reservoirs and possible reduction of storage in two others may result in some reduction of livestock grazing in the vicinity of Mine Area A. During mining operations, destruction of aquifers in the pit and dewatering of mined areas could cause a slight reduction in surface water flows in the area by reducing the amount of seepage to stream channels. However, all streams in the area are ephemeral and slight reductions of ground water seepage should be undetectable.

Table 37. -- Reservoirs, springs, and wells that may be physically removed or otherwise affected by Western Energy Company's proposed mining of Areas A and E near Colstrip, southeastern, Montana

<u>Physical Removal</u>	<u>Possible Reduced Storage or Yield</u>	<u>Mine Area(s) Affected</u>
<u>Reservoirs Containing Perennial Storage</u>		
	2N40E36AD	A
2N41E29DC		A
	2N41E30CA	A
2N41E31AC		A
<u>Springs</u>		
	2N42E31CBDC	E
<u>Wells</u>		
2N41E30DDAA		A
2N41E32DABB		A
1N41E02DACC		E
	1N41E03BBBB	A
1N41E06ACAB		A
1N41E06DDDB		A
<u>(2 Reservoirs, 5 Wells)</u>	<u>(2 Reservoirs, 1 Spring, 1 Well)</u>	

It has been estimated that only 0.1 percent of total precipitation in the area runs off as streamflow (Van Voast and Hedges, 1976). Mining in Areas A and E as proposed would disturb approximately 600 acres in each area. Runoff from each of these areas would be approximately 0.75 acre feet of runoff per year. These small volumes of water are insignificant to the areas' intermittent streams.

b. Ground water

(1) Primary impacts

As proposed, mining would destroy 1 well in Area E and none in Area A. If additional land in Areas A and E is eventually mined, then 5 wells in Area A would be destroyed but no others on Area E. Also, 1 well adjacent to Area A may have reduced yield (fig. 18 and table 36).

Mining of the Rosebud coal in Area A would create little change in the ground water system. The bed in Area A has a small recharge area and is dry or only partially saturated in much of the proposed mine area (fig. 17). Mine influent from the Rosebud coal bed should be negligible. Active pits that penetrate the Rosebud coal bed and extend the entire east-west dimension of Area A could intercept approximately 1,000 to 1,500 gallons of water per day that normally flows southeastward to the East Fork Armells Creek alluvium. When mining is completed in Area A, previously interrupted ground water flow to the alluvium should be mostly restored.

Mining of the Rosebud coal in the southern end of Area E began in December, 1974. Mine cuts have to date encountered very little water, thus, there has been no need to discharge the influent. Because of the low flow encountered in the southern end and the fact that mining has occurred to the east and north of the area, it is unlikely that much ground water would be intercepted.

Following mining, ground water availability would gradually resume and affected well and spring productivities outside the mined areas should be restored. Ground water should be obtainable from the mine spoils zone and from wells drilled to aquifers below the disturbed material. Completion of wells in mine spoils may be considerably more difficult than in undisturbed aquifers because the spoils will be fine grained, poorly sorted, and unconsolidated.

(2) Cumulative impacts

Cumulative ground water impacts from mining of Areas A and E should not be significant. Much of the Rosebud coal in Area A is presently dry or has only minor amounts of ground water regimes modified by previous and present mining in these areas.

c. Water quality

(1) Primary impacts

Ground water discharge into active mine cuts would consist of mixtures of waters from the disturbed aquifers. Under natural conditions these waters discharge to watercourses and in most places the rates are less than evapotranspirative demands. No significant changes in the chemical system are expected when natural ground water discharge is augmented by small amounts of mine effluent having the same or similar chemical quality. Dissolved-solids concentrations in effluents from Mine Areas A and E are expected to be less than 2,000 mg/l. Higher concentrations may occur at the north end of Area E because of induced flow from spoils of the old Rosebud Mine. Here the dissolved-solids concentrations may approach 3,000 mg/l. Effluents not used for dust control or other mining-related purpose would be discharged to watercourses if they are chemically similar to waters outside the mine areas.

Quality of ground water in spoils left by future operations would probably be as variable as the quality of water in the existing Rosebud mine. Cause of the variability is not clearly understood so specific predictions of effect on ground water quality cannot be made. Based on studies of present conditions, it can be expected that post-mining waters in Areas A and E would have dissolved-solids concentrations between 1,000 mg/l and 5,000 mg/l; that principal constituents of such waters would be magnesium and sulfate; and that some trace elements would be present in slightly higher concentrations than in pre-mining waters. The overall chemical differences between pre-mining and post-mining ground waters should ultimately be relatable to the final differences in aquifer materials. The coals and their waters would be stratigraphically replaced by inorganic spoils and by waters chemically similar to those in other non-coal aquifers.

As discussed earlier, ground water quality in the Colstrip region is highly variable and was highly variable before mining started. This natural variability has thus far made it very difficult to evaluate mining effects on ground water. The fact that no significant overall trend in ground water quality in the region has been observed to date is encouraging however.

It is likely that ground water quality in Areas A and E would be somewhat poorer following mining than under natural conditions. It is not possible to estimate just what the magnitude of the reduction will be. The total volume of water affected would be small because the present ground water volume in Areas A and E is small and the volume after mining should remain small.

(2) Cumulative impacts

Cumulative surface water quality impacts should be minor because the existing contribution to surface water from Areas A and E is minor. The combined estimated inflow to Mine Areas A and E is approximately 1,500 gallons per day or 1 gallon per minute. If it is assumed that this small volume of water would ordinarily reach streams in the area, and if its quality is reduced, it would have minor effect on existing surface water quality. Mining activities would leave the surficial soil materials of the disturbed mining area significantly more susceptible to erosion until substantial revegetation occurs. As a result, surface runoff would contain significantly more sediment load. However, the large majority of the eroded sediment would be retained in the water impoundments that would be constructed in each mining area. Overall, no noticeable change in sediment load concentrations is expected to occur in drainages downstream of the mine areas as a result of the proposed mining.

Cumulative ground water quality impacts include producing approximately 1,200 more acres of disturbed land which would contain ground water of somewhat reduced water quality. The volume of this water would be small; however it will contribute to the expansion of the area of slightly poorer quality ground water in previous mined areas. Also, some increase in trace metal concentrations would likely occur but the magnitude of the increase is not expected to be significant.

5. Other impacts

a. Refuse disposal

A review of refuse disposal for the shop, warehouse and crew building areas indicates that approximately 40 cubic feet of firmly

packed trash is disposed each day. This trash consists of the following major items:

- Sweeping - dirt from haul units, etc.
- Packing crates - wood
- Pasteboard boxes
- Oily rags
- Oil filters
- Steel cuttings - lathe and drill press
- Scrap iron - broken small parts
- Radiator hoses
- Tires - pickup sizes
- Plastic
- Welding slag
- Crew shack garbage

This material is disposed of in approved locations.

The monthly consumption of major petroleum products is approximately:

Oil	1,900 gallons
Anti-freeze	300 gallons
Solvent	1,200 gallons

Some of the oil used is changed in the field instead of the shop area. This work is normally done along the pit highwall where the oil is disposed of on the ground. During overburden stripping for the next cut, this waste is widely distributed throughout the spoils. It is WECO's policy that the remainder of the waste oil, anti-freeze and solvent is disposed of in areas approved by the DSL and shown on permit exhibits. WECO realizes that a more desirable solution for petroleum waste disposal is to recycle the waste. Accordingly, the company is attempting to locate a recycling firm that would take the petroleum waste products.

b. Noise

Mining noise in area A and E would not usually be heard in the town of Colstrip because most mining would be relatively far away from the town and the noisiest equipment would be located within the mining pit thus attenuating much of the noise. However, blasting of the overburden and coal bed would be audible in Colstrip. The overpressure created from these

blasts depends greatly on the weight of explosives detonated and on meteorological conditions. Measurement of similar blasts indicate that the impulse noise level produced at 1,000 feet from the blast area might be as high as 91 decibels^{1/}. This overpressure level exists for a very short duration and thus does not provide hearing damage risk and only minimal annoyance. An impulsive noise level of less than 140 dB is acceptable by standards of the Occupational Safety and Health Administration (Federal Register 20 May 1969). All blasting would be conducted during daylight hours, except in emergency situations.

The town of Colstrip is most affected by noise from the operation of power plants 1 and 2. The town is located 2,600 feet from the center of the plant site. Assuming hemispherical radiation and no effects of wind or terrain, the sound level at the nearest edge of Colstrip has been estimated at 60 dBA, and at the far end of town about 54 dBA (Environmental Systems, 1973). These estimated sound levels may be compared with those found normally in residential areas as follows:

- (1) Small town residential main street,
24-hour average = 44 dBA (U.S. Environmental
Protection Agency, 1973)
- (2) Other residential areas, excluding noise from
nearby sources such as children, animals,
vendors, etc. = 40-66 dBA (Harris, 1957)

^{1/}

Dames & Moore files, Billings, Montana.

B. Biological environment

1. Vegetation and agriculture

a. Short-term impacts

The impact of the mining on areas A and E would mean removal of all vegetation and production from agricultural lands in the immediate mine area. Additional areas of disturbance would include all roads, highways, etc., which would preclude agricultural use of this vegetation. These impacts would be experienced during actual mining of the area and would continue until reclamation has been achieved. The recovery time of the area to any productive use, including use by wildlife and livestock, cannot be predicted with present data.

Livestock production would be delayed for an unknown period after mining, while small grain production might possibly be resumed immediately after regrading the topsoil. However, under the Strip and Underground Mine Reclamation Act it must be demonstrated that the reclaimed land could produce a diverse cover of predominately native species before small grain production may begin on the area; even if the area was previously used for small grains.

Other short-term impacts on vegetation include that of soil and coal dust from mining activity. The impacts of the dust on vegetation could affect productivity of the vegetation on the native rangelands and on reclaimed lands. Dust may also interfere with either ingestion or digestion of plant material by livestock and or wildlife. The effects of dust on vegetation and the palatability to livestock may be influenced by many properties of the dust, including both chemical and physical aspects.

b. Cumulative and long-term impacts

Long-term impacts on agriculture and vegetation of area A and E would depend on the success of reclamation. Research on abandoned

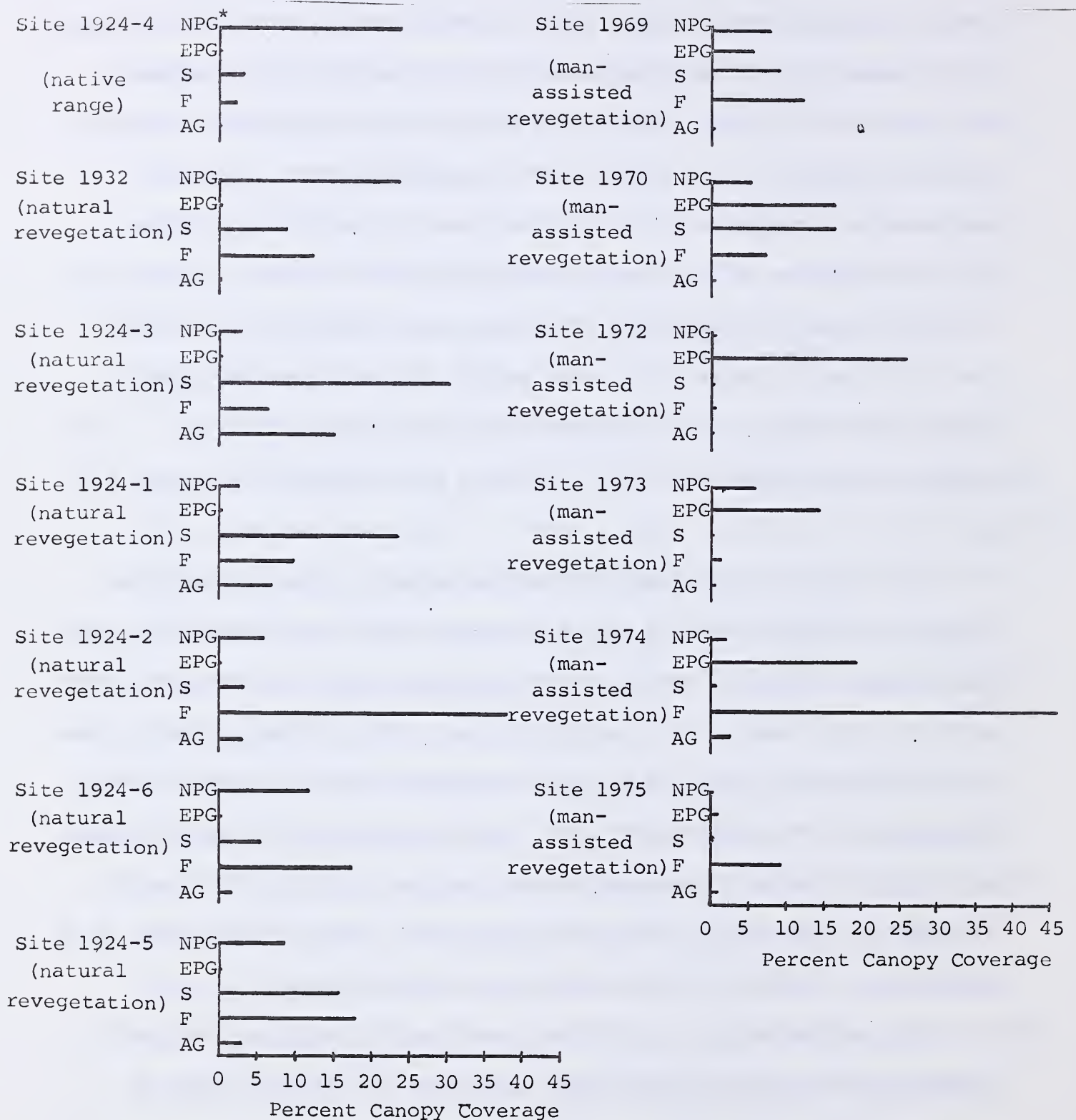
spoils which were graded during 1924 and 1932 cast some concern on the possible long-term recovery by natural revegetation. Long-term recovery for the 1932 areas has been relatively good (Ecological Consulting Service 1976a). However, older graded spoils in Area E show a very slow development of the community and considerable difference from the native rangeland. This data indicates that precise reclamation procedures should be used if recovery is going to take place in the foreseeable future. Figure 21 compares the percentages of native forbs, grasses, and shrubs, in the typical vegetation of Area E native grasslands with the data available for the old, naturally revegetated, strip mine spoils and data from the two year old recently seeded strip mine spoils. The data from the recently seeded strip mine spoils is from the Pit 6 area of Western Energy.^{1/} The seeding mixture used in Pit 6 is similar to that proposed for Areas A and E.

This depiction of current reclamation progress using man-assisted methods, indicates that much has to be accomplished in the future to insure that shrubs, forbs, and native grasses similar to those on native rangeland would be established on the revegetated mine spoils. Under present reclamation requirements, the species on the reclaimed area must have permanent diverse cover of predominantly native species and be able to feed livestock and wildlife species comparable to that previous to mining. This would indicate that the native shrubs and forbs of the area would also have to be established to provide similar pre-mining wildlife forage.

The reestablishment of crop land on old spoils areas may eventually become desirable; particularly where crop lands previously existed to mining. Available data from the Colstrip area (Meyn, Sundberg, & Young indicate that the winter wheat productivity of the original native soils

^{1/} Data collected by Montana Department of State Lands, 1976.

Figure 21. -- Coverage of native perennial grasses, shrubs, forbs and annual grasses on native range and reclamation sites.**



* NPG = Native perennial grasses which includes all perennial grasses except EPG.
 EPG = Exotic perennial grasses (Agropyron cristatum, Agropyron elongatum and Bromus inermis)
 S = Shrubs
 F = Forbs
 AG = Annual grasses

** Data from Sindclar and Plantenberg 1977

is not obtainable on reclaimed spoils even with extremely heavy applications of fertilizer. Without high applications of fertilizer the yield was even more drastically reduced on mine spoils. This data is limited to experimental plots but possibly points out the difficulty in returning spoils to their original productivity with regard to production of winter wheat. Such data also indicated that spring wheat production was higher on the spoils than on native soils, but much below winter wheat yields. The spring wheat crop also had much higher applications of fertilizer. Based on such data, it can be assumed that with the present state of knowledge, the ability to reclaim strip-mined crop land to its original productivity is somewhat questionable, if normal fertilizer rates are used. If high fertilizer rates are required to achieve "normal" yields, then the economics of these high application rates must be considered when evaluating reclamation success.

Other permanent long-term impacts on vegetation would be the removal of the research areas on the graded spoils along the northwest portion of Area E. The possible long-term impact of this action on all future reclamation efforts may be significant, assuming that this research, if continued, will provide needed information on reclamation.

Other long-term vegetation impacts would be the removal of the ponderosa pine and shrub communities in the area. Present reclamation data does not indicate that ponderosa pine or many of the native shrubs in the area can be permanently established on the graded spoils areas. The long-term effect would depend upon the results of reclamation research being conducted on these species. It is somewhat doubtful that any of the species requiring alluvial material and/or high water tables, such as the silver sage; or those requiring specialized soils, such as skunkbush sumac, ponderosa pine, and juniper; could again be permanently established on the proposed mine areas. The reproduction of such species may be the limiting

factor in restricting them to the peculiar soil types and the topographical areas in which they naturally occur in the Colstrip area. There are no current plans to attempt to restore any of the reclaimed area to these types of soil configuration. Thus, it can be assumed, that in the long-term, these plants will not be able to sustain themselves in the area. Some of these shrubs and trees, however, may be established for a single generation by transplanting techniques and other procedures that are commonly used in landscape architecture.

The diversity of plant communities on the proposed mine areas would also be lost on a long-term basis as the reclamation plan for the areas would restore the mined region to a very uniform soil type. Soil heterogeneity is an important variable in providing a variety of plant communities in the region. Eventually, some variety may develop in the establishment of vegetative communities as a result of weathering and exposure differences.

Available reclamation data indicates that exotic grass species and certain shrubs may be established in a relatively short period of time giving a relatively high ground cover and high seasonal biomass productivity. This productivity (short-term) is often in excess of that occurring in native rangelands (Hodder, Sindelar, and Majerus 1973a 1973b, Dalsted and Leistritz 1973, Sindelar, Atkinson and Proctor 1974). Such vegetation establishment should stabilize soil and be of some beneficial use to livestock and wildlife species. However, the current reclamation and seeding plan for the area does not include seeding of primarily exotic grass species which are more readily established on the spoils, since these apparently inhibit the development of native species.

Long-term impacts resulting from additional mining in Areas A and E are related to both the rate that additional surface areas are disturbed

for strip-mining and the success of the reclamation process. In summary, such long-term impacts include: possible permanent reduction of crop land productivity in Area E, the elimination of the research area on graded spoils in Area E, a reduction in the number of plant communities and vegetation diversity in both proposed mining areas, probable permanent removal of shrub and ponderosa pine communities in both proposed mining areas and possible reduction in the land's ability to sustain pre-mining grazing pressure as is currently practiced in the Colstrip area. As it is now a national policy to utilize western coal as a primary energy source, the cumulative impacts of strip-mining upon native vegetation will undoubtedly accelerate. As additional acres are disturbed for coal production the magnitude of the impact, should widespread reclamation prove unsuccessful, will grow in severity.

2. Wildlife and aquatic environments

a. Short-term impacts

Most wildlife species would leave the mined portions of Areas A and E for the duration of the mining. Associated short-term impacts would include behavioral disturbances on adjacent lands because of the mining activity. A continuation of the social impacts related to hunting and trespass problems caused by increased population on the Colstrip area as a result of the mining operations would also be likely. Short-term aquatic impacts would include the destruction of the standing water in the coal pit in the northwestern portion of Area E.

Increases in coal and other mining related dust may have minor impacts on Armells Creek aquatic life. Also, increased haul-road lengths and additional exposed earth may cause an increase of sediment runoff during intermittent storms and spring snow melt. Such runoff could

decrease water quality in Armells Creek and thus have a degrading effect on the aquatic life within the creek.

b. Cumulative and long-term impacts

As with the vegetation, long-term impacts on wildlife and aquatic life are dependent upon the success of reclamation processes and associated soil stabilization. Successful reclamation of certain vegetation species such as big and silver sage, would somewhat mitigate the impact of strip mining. Other shrub species utilized by wildlife, however, have lower probabilities of being on mined lands. Other aspects of local wildlife habitat such as cover provided by ponderosa pine, and to a certain extent the area's broken topography croppings and the scoria areas would be eliminated in the long-term. This is particularly true for Area A.

Non-game species would also be affected in that certain species require vegetation types or topographical features that will not be reestablished in the reclaimed lands. Wildlife species such as songbirds dependent on sandstone outcroppings and birds or mammals dependent upon ponderosa pine or sagebrush may be permanently removed from the immediate area because of lack of habitat. The well-being of a wildlife species is also often dependent on plant community diversity. Native rangeland in Colstrip area consists of at least seven distinctive community types. Reclaimed surfaces however would essentially contain one continuous community type in which only minor diversity occurred as a result of microtopography and microclimate changes. Such lack of diversity would eliminate ecotonal types of habitats and thus the variety of community types available for use by songbirds, small mammals, and large game species.

Cumulative impacts of the mining activity beyond the immediate permit area are to be addressed in a regional impact statement currently being prepared for the Northern Powder River Basin. The Rosebud mine is only one of several mines that will continue to expand in the region as the demand for coal increases. Long-term impacts to be addressed by the Northern Powder River Basin EIS Team include: the general effect of the "boom town" development in the Colstrip areas and the associated wildlife impacts because of increased noise levels, food and cover lost to associated development, increase of air pollutants, increases from dust and electrogeneration units, increased legal and illegal hunting pressures and increased traffic on roads and railroads. Such activities could help decrease the quality of life in the Colstrip area by causing more land to be posted for hunting and increasing tension between local land owners and other residents of the area, and a general decrease in the aesthetic values of the topographical and vegetative features.

C. Human environment

The proposed action in this draft EIS involves Rosebud Mine expansion at Colstrip. This expansion would only maintain current levels of production and employment and thus would not increase the level of coal mining activity in Rosebud County. Should the mining plans for Areas A and E be approved there would thus be little impact on the economy and socio-economic environment as covered in this portion of the EIS. Less obvious are the consequences of not granting the permits for Areas A and E. Such an action would lower mining employment and cause other changes in the county.

The following population, economic and social services assessments have been made utilizing two alternatives -- one without Colstrip

electrogenerating Units 3 and 4 becoming operational and the other with them; the land use, archaeological, historical, recreation aesthetics, and transportation assessments are discussed only with regards to the proposed expansion activity.

1. Population and economics

- a. Analytic framework

The following social and economic assessment depends on an assumed set of relationships among the various demographic and economic variables in the area under investigation. This assumed set of relationships is often referred to as a model and much of what comes out of the analysis is a direct consequence of the assumed structure of the model. The model used in this study and the assumptions it makes are briefly explained in Appendix E.

As forecasting involves an inexhaustible list of possible events and of factors that may cause their occurrence, social scientists have increasingly resorted to models that assume that the quantities to be predicted are functions of a relatively small number of variables. The models used for this EIS (Appendix E) do not pretend to be able to forecast variables such as population and employment with complete accuracy. However, if the model and development alternatives are carefully constructed, the results will be useful. The more certain the development alternatives, the more accurate the results will be. Since the immediate future is clearer than ten or fifteen years from now, the results predicted for the next five years will be more defensible than those for farther in the future.

In the following discussion, a set of basic employment forecasts is constructed for the impact area. Basic employment is the activity

which generates new income in the area and is composed primarily of the agriculture, mining, and manufacturing industries.

b. Agriculture

Agriculture has historically been the most important industry in Rosebud County. However, as indicated in Chapter II, agricultural employment has been declining steadily as farming and ranching operations have become more capital-intensive. Nevertheless, land use in the county is still predominantly agricultural; over 90 percent of the acreage is committed to agricultural uses. The 1975 Situation Statement for Rosebud County reports that the livestock industry dominates with cattle and calves in the lead. The major crop is wheat followed by barley and corn.

With approximately 75,000 feeder cattle available in Rosebud County each fall, there is a natural opportunity for employment growth in the development of feedlots and packing plants. However, the present slump in the industry because of low cattle prices makes the possibility of development in this area highly unlikely in the near future.

In summary, it is doubtful that there will be sufficient increased activity in the study area to expect an increase in agricultural employment. Increase capital usage, although not as large a change as occurred during the past 25 years, will probably cause agricultural employment to continue to decline; however, the increased capital may cause agricultural incomes to increase but not dramatically. Also, with increased nonagricultural job opportunities, the number of available farm workers will be smaller, and there will probably be a demand for higher wages which could cause decreased income for the farm owner.

Based upon this information, it was decided to construct a single forecast of agricultural employment for the study area. Beginning with the agricultural employment in the study area of 714 in 1974, this was reduced by one percent per year, which results in the agricultural employment forecasts in table 38. In order to account for increases in capital usage and productivity, agricultural income is assumed to grow at an annual rate of three percent.

Table 38.-- Forecasted agricultural employment-
Rosebud County, 1975-1985

(source: derived by Mountain West Research, Inc.)

<u>Year</u>	<u>Number</u>
1975	714
1976	707
1977	700
1978	693
1979	686
1980	679
1981	672
1982	665
1983	659
1984	652
1985	646

c. Manufacturing

Traditionally, manufacturing has not been a major employer in Rosebud County. Most of the county industrial activity is concentrated in the wood products industry, which includes timber harvesting, timber thinning, and sawmills. This industry is generally confined to the southern part of the study area with the Eastmont Lumber Company in Ashland and the Black Sawmill in Lame Deer; however, the Eastmont Lumber Company

burned in 1972 and caused a loss of about 20 jobs. There is some interest in harvesting cottonwood along the Yellowstone River by a firm in Miles City. Interest has also been shown in the pine on the Northern Cheyenne Reservation by a firm in Sheridan, Wyoming; and, recently, there has been increased activity in thinning operations on the reservation. Even if the proposed expansions of Areas A and E were approved, neither should have a substantial impact on wood-products related employment.

The only other large employer in the manufacturing sector is Guild Arts and Crafts in Ashland. Although over 100 persons have been employed there since 1970, the company has recently reduced their work force, and it is unknown whether the company will sustain its present level of employment.

From this information, the employment forecast outlined in table 39. has been developed. The increase in 1976 of 20 persons reflects the reopening of the Eastmont Lumber Company. Since no large, identifiable increases are expected, manufacturing employment is assumed to grow one percent per year after 1976. This assumes that Guild Arts and Crafts will continue to operate and employment in the timber industry will gradually increase.

Table 39.-- Forecasted manufacturing employment-
Rosebud County, 1975-1985

(derived by Mountain West Research, Inc.)

<u>Year</u>	<u>Number</u>
1975	182
1976	202
1977	204
1978	206
1979	208
1980	210
1981	212
1982	214
1983	216
1984	219
1985	221

d. Mining and related activity

The expansion of Areas A and E by WECO would not increase mining employment in Rosebud County and thus would have little or no impact on the County's economy. Therefore, rather than examining the impact of allowing the expansion, the opposite is analyzed; that is, what is the impact of not issuing the permit? WECO maintains that the expansion of Areas A and E are necessary to sustain production and fulfill current contracts. Presently WECO employs 300 persons and forecasts total production of 8.93 million tons of coal during 1977. Production from Area E is expected to account for 3.57 million tons with 4.00 million tons from Area A. Approximately 60 workers are involved in the operation of Area E and 90 are supported by activity in Area A. It was estimated by a WECO representative that Area A would have to be shut-down immediately and Area E within a year were the pending permits not granted (personal communication: Michael Grende, permit supervisor, Western Energy Co.). Therefore, 60 employees would be lost in 1977 and 90 by 1978 for a total reduction of 150.

If those parts of the mine are closed, the Montana Power Co. would have to ship coal in by rail from other areas and the increased railroad employment would somewhat offset the loss in mining employment. Colstrip Units 1 and 2 use about 3.0 million tons per year and Units 3 and 4, if built, would use an additional 4.25 million tons. Thus, it is estimated that railroad employment would increase by 20 with the closing of the areas and without the construction of Units 3 and 4 and would increase by 40 if Colstrip Units 3 and 4 are built.

The construction of Units 3 and 4 would have a substantial impact on Rosebud County and the impact assessment of Areas A and E must, therefore,

be made in the context of two alternatives. Alternative Future 1 (AF1) assumes that construction of Units 3 and 4 does not occur, thus reducing the overall level of activity in the county. The second alternative (AF2), incorporates the construction of the two units beginning in 1978 with the construction period lasting five years. Two scenarios, in turn, are associated with each of these futures. Scenario 1 assumes that the mining permit is issued and that current levels of mining are maintained. Employment levels associated with this scenario (under each alternative future) are presented in tables 40 and 41.^{1/}

Scenario 2 assumes that the mining permit is denied. The employment loss resulting from this action is subtracted from the employment estimates given in the previous two tables. The resulting changes in employment are given in tables 42 and 43.^{1/}

To project reasonable populations for Rosebud county, three other projects are included:

1: Employment at Peabody's Big Sky Mine is assumed to expand from 70 to 100 employees in 1978 and remain at that level throughout the projection period (to 1985). Construction employment associated with this expansion is assumed to be 40 in 1977 and 15 in 1978.

2 and 3: Two 10-million ton per year coal mines are assumed to open near Ashland by 1985 with construction beginning in 1980 and lasting through 1983 for both mines. Each would employ 215 permanent workers.

The population projections of these three other projects do not change with either of the alternative futures.

^{1/} Employment data associated with the Colstrip electro-generating units was derived from the Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 and 4, 500 Kilovolt Transmission Lines and Associated Facilities (Montana Department of Natural Resources and Conservation, 1974).

Table 40. -- Employment associated with permit issuances
for areas A and E - with Colstrip power
plants 1 and 2 - 1975-1985 (AF1 S1)
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Construction</u> <u>Employment</u>	<u>Power Plant</u> <u>Employment</u>	<u>Mining</u> <u>Employment</u>	<u>Railroad</u> <u>Employment</u>	<u>Total</u>
1975	1475	60	300	25	1860
1976	500	90	300	25	915
1977	300	100	300	25	725
1978	---	100	300	25	425
1979	---	100	300	25	425
1980	---	100	300	25	425
1981	---	100	300	25	425
1982	---	100	300	25	425
1983	---	100	300	25	425
1984	---	100	300	25	425
1985	---	100	300	25	425

Table 41. -- Employment associated with permit issuances
for areas A and E - with Colstrip power
plants 3 and 4 - 1975-1985 (AF2 S2)
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Construction</u> <u>Employment</u>	<u>Power Plant</u> <u>Employment</u>	<u>Mining</u> <u>Employment</u>	<u>Railroad</u> <u>Employment</u>	<u>Total</u>
1975	1475	60	300	25	1860
1976	500	90	300	25	915
1977	300	100	300	25	725
1978	325	100	300	25	750
1979	1000	100	300	25	1525
1980	1475	125	350	25	1975
1981	950	175	400	25	1550
1982	325	200	450	25	1000
1983	---	200	500	25	725
1984	---	200	500	25	725
1985	---	200	500	25	725

Table 42. -- Employment change associated with permit denials
for areas A and E - without Colstrip power
plants 3 and 4 - 1975-1985 (AF1 S2)
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Mining Employment</u>	<u>Railroad Employment</u>	<u>Total Change</u>
1975	0	0	0
1976	0	0	0
1977	- 90	0	- 90
1978	-150	20	-130
1979	-150	20	-130
1980	-150	20	-130
1981	-150	20	-130
1982	-150	20	-130
1983	-150	20	-130
1984	-150	20	-130
1985	-150	20	-130

Table 43. -- Employment change associated with permit denials
for areas A and E - with Colstrip power
plants 3 and 4 - 1975-1985 (AF2 S2)
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Mining Employment</u>	<u>Railroad Employment</u>	<u>Total Change</u>
1975	0	0	0
1976	0	0	0
1977	- 90	0	- 90
1978	-150	20	-130
1979	-150	20	-130
1980	-200	20	-180
1981	-250	30	-220
1982	-300	35	-265
1983	-350	40	-310
1984	-350	40	-310
1985	-350	40	-310

Table 44.-- Other mining activity in Rosebud County 1975-1985
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Construction Employment</u>	<u>Mining Employment</u>	<u>Total Employment</u>
1975	---	70	70
1976	---	70	70
1977	40	70	110
1978	15	100	115
1979	---	100	100
1980	180	130	310
1981	340	130	470
1982	340	340	680
1983	180	530	710
1984	---	530	530

The total additional mining activity is summarized in table 44. It should be noted that the actual level of activity may be higher or lower than that indicated. Coal development near Ashland will depend on the construction of a railroad spur either from Decker or from Colstrip. In any case, it is only included to estimate the magnitude of other activity in the county and will not materially affect the impact of the proposed action.

In summary, four different projection bases have been developed-- two alternative futures (AF1 and AF2) and two scenarios (S1 and S2). The projections derived from (AF1 S1) will be compared to those using AF1 S2. Likewise, projections with (AF2 S1) will be compared to those from AF2 S2. AF1 S1 and AF1 S2 are portrayed in table 45 and AF2 S1 and AF2 S2 in table 46.

Table 45. -- Alternative future 1 - comparing scenarios 1 and 2
Rosebud County - 1975-1985
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Construction Employment</u>		<u>Mining Employment</u>		<u>Power Plant Employment</u>		<u>Railroad Employment</u>		<u>Total Employment</u>	
	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>
1975	1475	1475	370	370	60	60	25	25	1930	1930
1976	500	500	370	370	90	90	25	25	985	985
1977	340	340	370	280	100	100	25	25	835	745
1978	15	15	400	250	100	100	25	45	540	410
1979	---	---	400	250	100	100	25	45	525	395
1980	180	180	430	280	100	100	25	45	735	605
1981	340	340	430	280	100	100	25	45	895	765
1982	340	340	640	490	100	100	25	45	1105	975
1983	180	180	830	680	100	100	25	45	1135	1005
1984	---	---	830	680	100	100	25	45	955	825
1985	---	---	830	680	100	100	25	45	955	825

Table 46. -- Alternative future 2 - comparing scenarios 1 and 2
Rosebud County 1975-1985
(Source: Mountain West Research, Inc.)

<u>Year</u>	<u>Construction Employment</u>		<u>Mining Employment</u>		<u>Power Plant Employment</u>		<u>Railroad Employment</u>		<u>Total Employment</u>	
	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>	<u>S1</u>	<u>S2</u>
1975	1475	1475	370	370	60	60	25	25	1930	1930
1976	500	500	370	370	90	90	25	25	985	985
1977	340	340	370	280	90	90	25	25	835	745
1978	340	340	400	250	100	100	25	45	865	735
1979	1000	1000	400	250	100	100	25	45	1525	1395
1980	1655	1655	480	280	125	125	25	45	2285	2105
1981	1290	1290	530	280	175	175	25	55	2020	1800
1982	665	665	790	490	200	200	25	60	1680	1415
1983	180	180	1030	680	200	200	25	65	1435	1125
1984	---	---	1030	680	200	200	25	65	1255	945
1985	---	---	1030	680	200	200	25	65	1255	945

e. Impact analysis

The analysis utilizes the four sets of projections derived from the model and the development alternatives described above. It is extremely important to note that the alternatives and projections are not designed to be extremely accurate, but only to provide a basis from which to analyze the impacts of the proposed actions. No attempt has been made to include all the development potential in the region that may affect Rosebud County. Specifically, the area south of the Northern Cheyenne Reservation was not included since it is somewhat isolated from the immediate impact area. Similarly, coal conversion potential near Ashland has not been examined. The analysis does provide, however, reasonable projections of the economic impacts of the proposed action.

(1) Population

Alternative Future 1 assumes that Colstrip 3 and 4 are not built and is used in conjunction with Scenarios 1 and 2. The population projections associated with S1 and S2 are given in Appendix E and portrayed in figure 22. The shaded area shows the impact directly associated with the proposed action. The decline associated with closing the area (AF1 S2) is 240 in 1977 when area A is shut down and this increases to 397 in 1979 with a reduction of 385 by 1985. The final population under S2 is approximately 95 percent of that for AF1 S1. Under either series, the population of the county falls substantially in 1978 when all construction activity on Units 1 and 2 is completed. It is interesting to note that the Anglo population is lower in 1985 compared to 1977, but the increase in Northern Cheyenne population is more than enough to offset the loss, resulting in a net gain for the period.

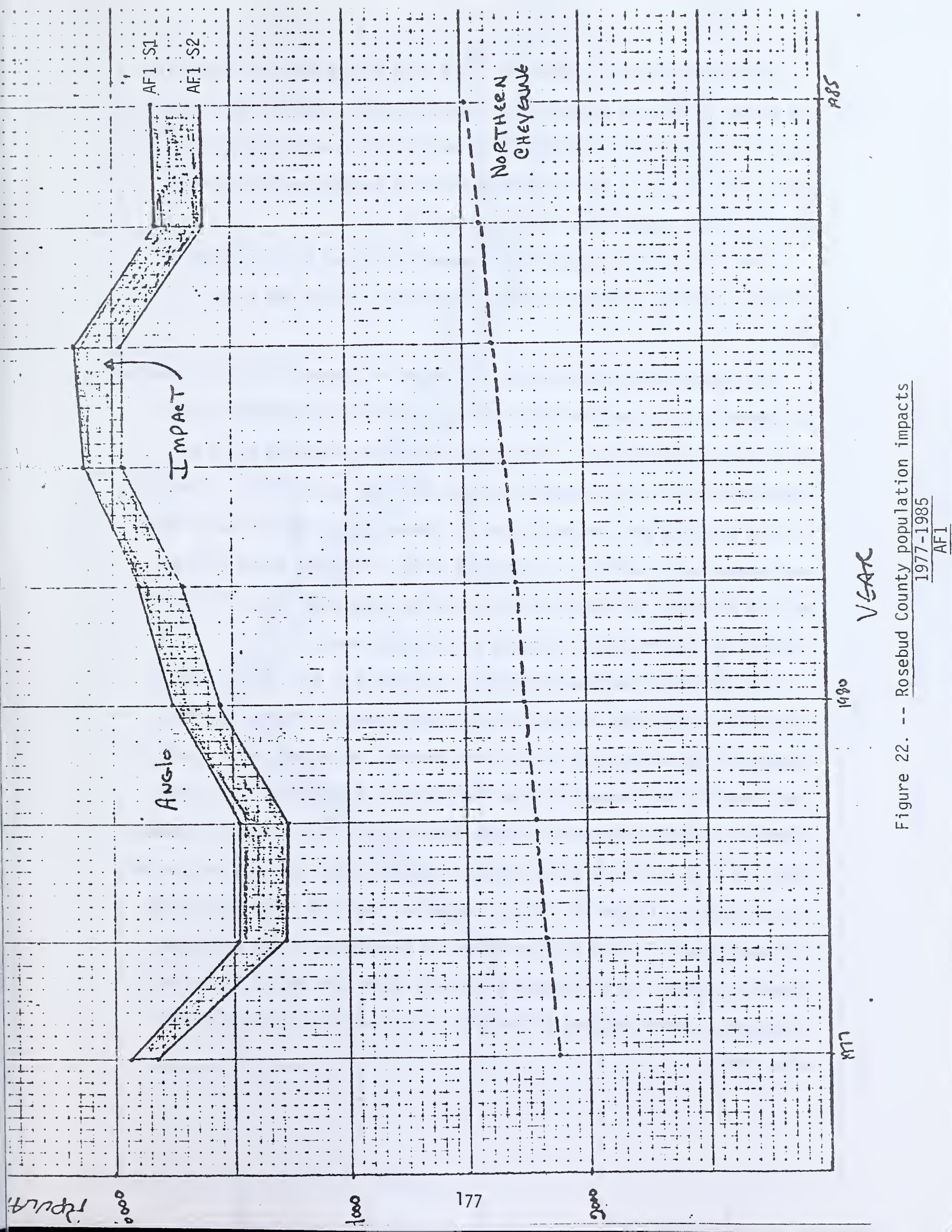


Figure 22. -- Rosebud County population impacts
1977-1985
AFI

The corresponding figures for AF2 S1 and S2 are given in Appendix E and figure 23 and are based on the assumption that Colstrip Units 3 and 4 are built. Since the direct impact of AF2 S2 is much greater than that of AF1 S2, it is not surprising that the population effect of AF2 S2 is much larger than it was for AF1 S2.

The difference in population between AF2 S1 and AF2 S2 is 240 in 1977 and steadily increases to 862 in 1982 and by 1985 the loss is 852.

The populations projected for the principal communities are presented in Appendix E and show that most of the impact of the proposed action will be felt in Colstrip. The population of the community would be approximately 140 less under AF1 S2 and 664 less under AF2 S2. Forsyth is also affected and its population is reduced by 60 and 134 under the two assumptions. Ashland is projected to be influenced about half as much as Forsyth. No impact is indicated for Lame Deer since it is assumed that no incoming residents will locate there.

The Northern Cheyenne population, indicated by the broken line in figure 24 is the same for each of the futures as all changes for this subpopulation are assumed to rise from natural increase. As a result of the "no-migration" assumption and the relatively high fertility rates, there is a steady increase in Indian population. This natural increase leads to a shifting age distribution of the Northern Cheyenne population as indicated by figure 24. This chart shows that the large population of young people in 1977 has increased the proportion in the middle-age groups in 1985. The percentage of Indians under the age of 15 has also increased, indicating that the middle age groups may grow even faster after 1985.

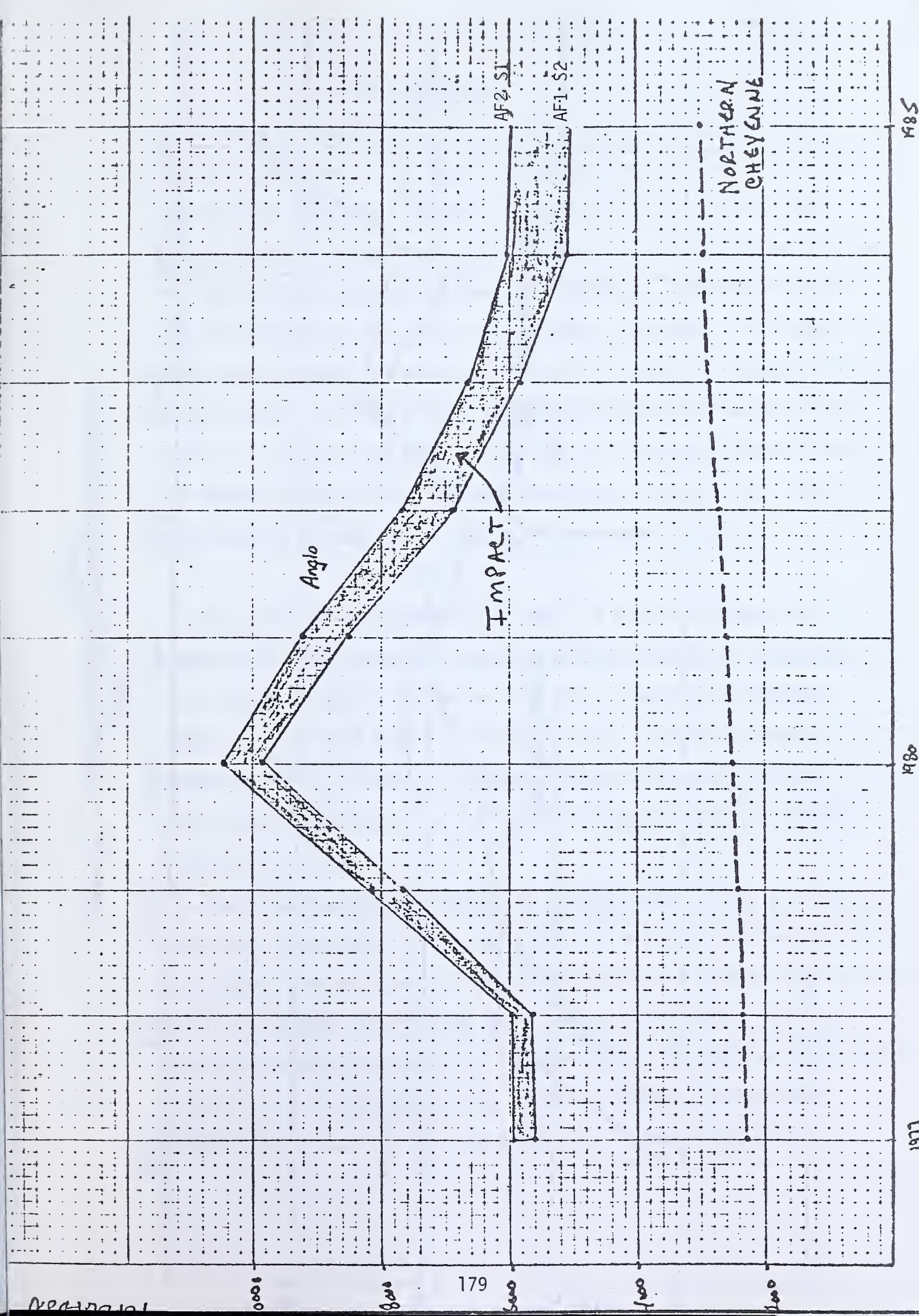


Figure 23. -- Rosebud County population impacts
1977-1985

AF2

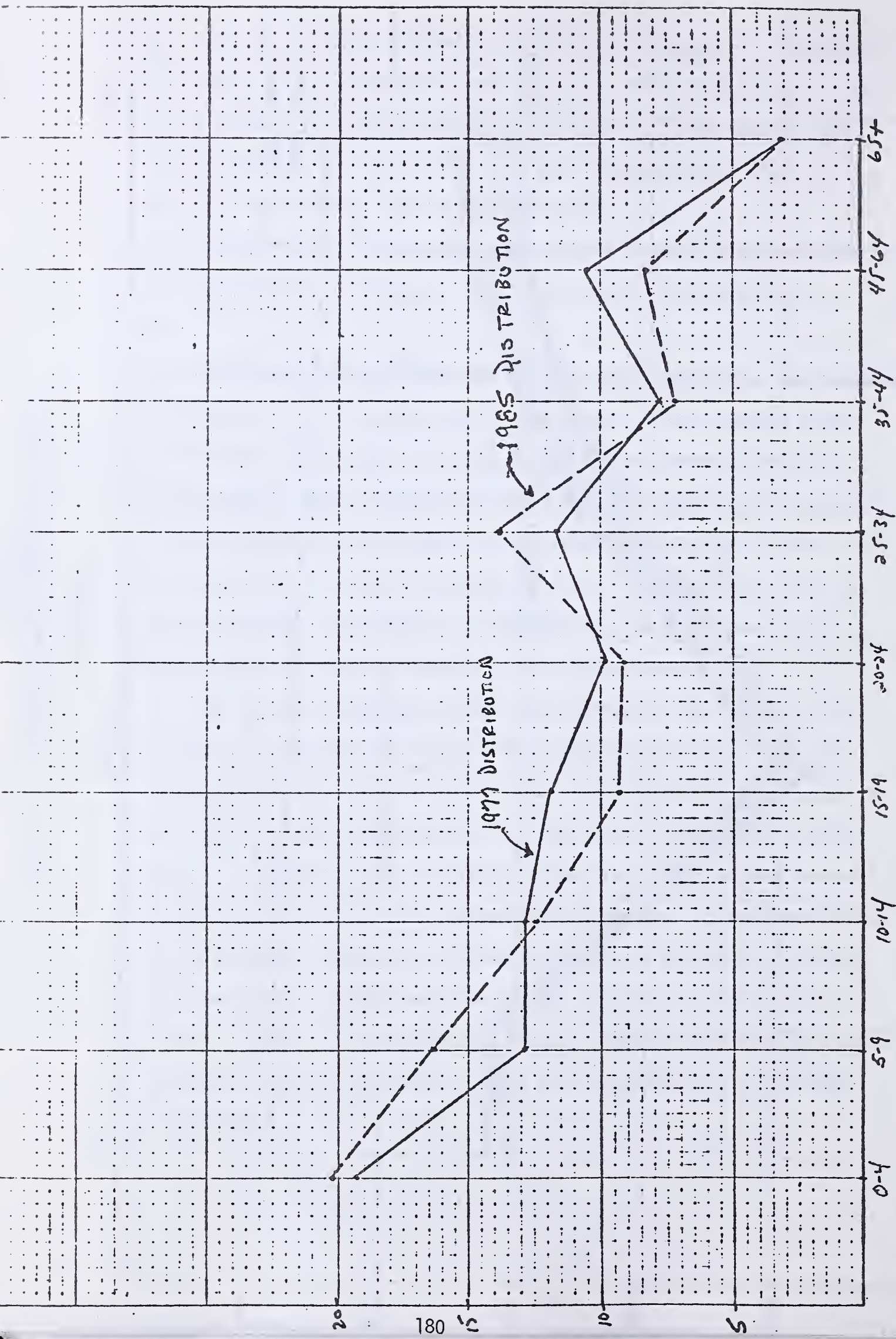


Figure 24. -- Northern Cheyenne population distribution

1977-1985

(2) Employment

Figures 25 and 26 show the employment impacts associated with closing areas A and E. The total employment effect of the loss of 130 basic jobs is about 180, yielding a multiplier of 1.4. Of the total loss, 155 were projected to be held by Anglos and 27 by Northern Cheyenne.

AF2 S1 and S2 produce substantially different results due to the large fluctuations in construction and mining employment. The number of non-Indians employed increases for 111 in 1977 to 378 in 1982 then falls to 341 by 1985. In view of the large demand for workers during the construction of Units 3 and 4, S2 has no impact on Northern Cheyenne employment between 1979 and 1981. After construction, the job loss, directly and indirectly related to the closing of the areas is 66.

(3) Income

The effect of development on incomes can best be evaluated by examining the real per capita income in Rosebud County. If development occurs, total income in the region will rise. However, development usually attracts more people which may actually reduce the amount of income per person. Since the proposed action is expected to impact differently on the Anglos and the Northern Cheyenne, both are included in table 47.

The results project a widening of the per capita income differential between the two groups. Although, within the model, the Northern Cheyenne are allowed to obtain some of the high wage jobs in mining and construction, this is not enough to offset the large number in low wage sectors and the growing Indian population. Even under AF2 S1 in 1980 when construction of Units 3 and 4 is at a peak, the difference between the Anglo and Northern Cheyenne per capita incomes still is larger than in 1977.

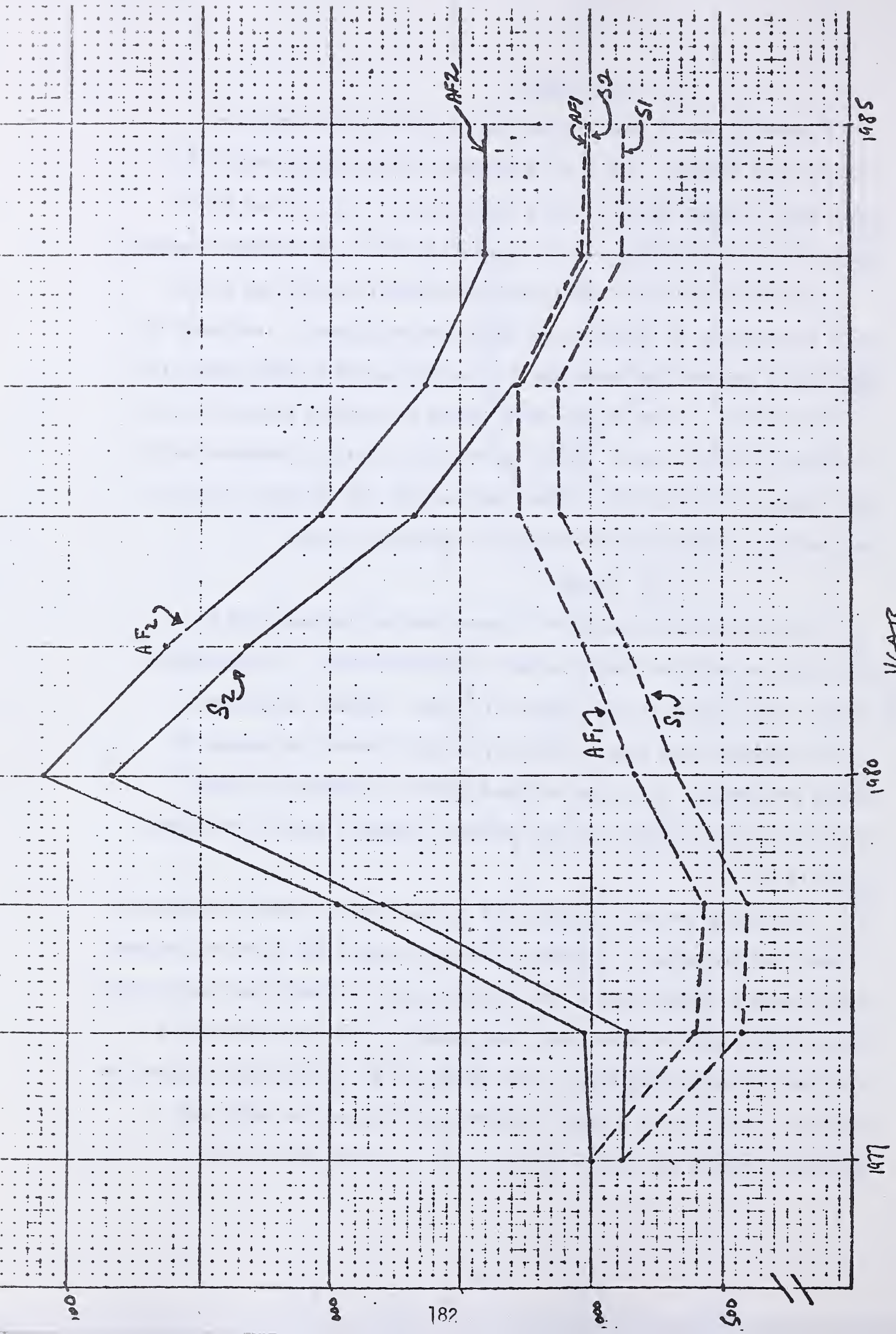


Figure 25. -- Rosebud County employment impacts
1977-1985
ANGLO

VEAR

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Table 47. -- Income impacts per capita nonagricultural labor income, Rosebud County
(Source: Mountain West Resource Inc., 1977)

(Dollars)

<u>Year</u>	<u>Anglo Income</u>			<u>Indian Income</u>		
	<u>Alt. Fut. 1</u>	<u>Scen. 1</u>	<u>Alt. Fut. 2</u>	<u>Alt. Fut. 1</u>	<u>Scen. 1</u>	<u>Alt. Fut. 2</u>
1977	4111	3971	4111	2643	2550	2643
1980	4262	4148	5629	2348	2217	3026
1985	4970	4914	5575	2704	2181	2606
						2339

2. Social services

For reference and informational purposes, this portion of the EIS continues the use of the alternative futures established in the preceeding population and economic section. In essence, this information goes beyond just the issuance of a permit for continuing mining operations in areas A and E because the only impacts that will occur are those associated with the closing of the A and E area mines. To reiterate, no social structure or social services impacts are anticipated from extension of on-going mining activity into areas A and E.

a. County and reservation services under AF1 and AF2

The demand for county-wide services is not expected to be greatly affected under either of the alternative futures. The impact of not issuing a mining permit to areas A and E would be to generally reduce the demand for services in the county.

Under Alternative Future 1, demand for services provided by the county (e.g., county health facilities, libraries, law enforcement services, etc.) is expected to increase marginally from 1980 through 1985, but currently proposed expansion plans should be sufficient to adequately handle this growth. Assumptions built into Alternative Future 2 generate large county population increases to 1980 with a rapidly declining population to 1985. Although some neutralization may result, the relatively rapid decrease in population should preclude any large expansions. Furthermore, many of these services would be provided by impacted communities within the county.

The effect of not issuing the mining permits would be to lessen the strains under either alternative. Growth in populations would still occur but to a lesser extent.

Services provided on the Northern Cheyenne Indian Reservation are not expected to be affected under any of the alternatives considered here. Such services would increase in response only to natural population growth. Proposed expansion of current facilities would be necessary to maintain or increase the present level of services on the reservation.

b. Municipal services

The effects of coal development projects will be quite different for individual communities. The demands placed on community facilities is directly related to the projected population each municipality is expected to receive. Demands projected under each alternative are presented in Appendix E.

Under the assumptions of the model, the most heavily affected community would be Colstrip, if Units 3 and 4 are put into operation. Under Alternative Future 2, (\$1) municipal services will be under severe strain by 1980, but this will quickly dissipate by 1985; this is true even if mining Areas A and E are closed.

It is difficult to estimate the impacts on other communities in Rosebud County. Many facilities are already under expansion to facilitate projected population increases. It is believed that these projects would be sufficient for any increased demands. The effect of not granting the proposed mine expansions for areas A and E would be to lessen the demands for facilities.

Social services in Forsyth appear to be able to handle the projected increases. The sewer system will definitely need to be expanded. Ashland provides little in the way of municipal services. Consequently, the town will be forced to expand existing facilities or increases in county population will be diverted to other communities. Lame Deer will be sufficiently supplied by reservation facilities.

c. Educational facilities

To analyze the impacts on school facilities, only expected community enrollments under the two alternative futures (with the permit) are presented. If facilities are adequate to handle these increases, then supply will be sufficient under the proposed action.

Expected enrollments under either alternative future in almost all communities are below estimated capacities of district schools. These are presented in table 48. Again, Colstrip enrollments with the construction of Units 3 and 4 will be greater than present capacities. However, this shortage will disappear by 1985. Temporary facilities may be more economical than permanent expansion of facilities beyond already planned increases.

All other communities appear to be within the projected capacities. The effect of not granting the proposed mine expansions would be to lessen these impacts generated under the alternative futures.

d. Housing

Although the expansion of WECO's on-going mining level activity in areas A and E would not impact private services such as housing, shortages are expected when and if Units 3 and 4 are constructed (as shown in AF1 and AF2). Table 49 shows the projected number of households under each possible assumption.

Colstrip is again the most impacted area under each alternative. However, this town does have the greatest capacity for expansion. In the event that Units 3 and 4 are started, there will be 400-600 additional housing units.

Forsyth also is believed to have the ability to absorb the projected increases from Units 3 and 4. With new housing development occurring in the town, it is expected they will have a sufficient supply of housing under each alternative.

Table 48. -- Projected school enrollments - Rosebud County
 (Source: Mountain West Research, 1977)

	<u>1977</u>		<u>1980</u>		<u>1985</u>	
	<u>AF1</u>	<u>AF2</u>	<u>AF1</u>	<u>AF2</u>	<u>AF1</u>	<u>AF2</u>
FORSYTH						
Elementary	388	388	356	446	362	370
High School	122	122	112	141	114	117
COLSTRIP						
Elementary	271	271	257	1046	247	336
High School	86	86	81	330	78	106
ASHLAND						
Elementary	141	141	195	222	257	261
High School	45	45	61	70	81	82
LAME DEER						
Elementary	222	222	243	243	281	281
High School	70	70	77	77	89	89

Table 49. -- Projected households for selected communities
in Rosebud County
 (Source: Mountain West Research, 1977)

	<u>FORSYTH</u>	<u>COLSTRIP</u>	<u>ASHLAND</u>	<u>LAME DEER</u>
		<u>AF1</u>		
1977	660	462	240	378
1980	604	437	331	412
1985	614	419	436	477
		<u>S1</u>		
1977	645	405	236	
1980	546	333	328	
1985	595	375	426	
		<u>AF2</u>		
1977	660	462	240	
1980	758	1777	378	
1985	628	570	443	
		<u>S2</u>		
1977	645	405	236	
1980	740	1620	372	
1985	586	363	419	

Lame Deer is in much the same situation as Forsyth. Present expansion of housing will bring supply up to absorb projected increases.

Unless there is some expansion of housing facilities in Ashland, growth will be diverted to other communities. Approximately 100-200 new units would be needed to accommodate projected increases in AF1 and AF2.

e. Other private services

If the population increases in the impact area as delineated in AF1 S1 and AF2, S1, additional private services would be needed. There would be some increased demand for dentists, optometrists, medical doctors, and nursing facilities. There would also be some expansion of demand for natural gas and electricity services. The demands for these services would only be slightly larger under Alternative Future 2 Scenerio 1. Retail services may not increase due to an already existing dynamic business community.

f. Cumulative environmental impacts

The principal effect of the proposed actions (extension of on-going mining in mine areas A and E) is that it would maintain the projected levels of population, employment, and income of Rosebud County. The issuing of the permits would not increase these variables since it would not create additional employment opportunities or other economic activity.

The impact of not allowing the expansion of Areas A and E would be to reduce the projected population of the county by 5-10 percent and cause similar decreases in employment. The Anglo per capita figure would decrease by ten percent.

3. Social structure

It is not anticipated that the expansion of the Areas A and E portions of the Rosebud mine would cause impacts to the area's social structure that would be measurable within the scope of the existing data. Mine employees are, for the most part, already residents of the Colstrip-Forsyth vicinity, and miners, whose jobs are long-term, tend to adopt local attitudes towards the land and people after several years residence.

4. Land use

The major impact of extending the existing mining operations and related linear elements into the unmined areas of A and E is manifested by the change of the unmined land from range to mining area. The impact of this change is measured by the resultant changes in the physical character and properties of the site. Such changes are covered under impacts to the physical and biological environments (Sections IIIA and IIIB) and in the archaeological-historical and recreation-aesthetics portions of this section on social and economic environment.

A general overview of the southcentral Montana area shows that the majority of acres of strippable coal underlie rangeland. Struck (1975) noted that a critical potential land use conflict does not exist between strip mining and dry or irrigated farmland and further that

All agricultural land that is stripped, whether rangeland or cropland, will be removed from productive use during mining; when it will be returned to agricultural use, and to what type of use, have not yet been determined. Due to legal restrictions, stripped cropland is currently being reclaimed as rangeland, and, even if reclamation efforts are successful, it cannot be reconverted to crop use for a statutory minimum of five years.

Further, Struck notes that the strip mining of southeastern Montana coal will contribute to the altering of the area's character from agricultural to industrial. However, given the size of the region, this statement needs to be tempered before application to all of the region's land use pattern.

5. Transportation

The extension of strip mining in areas A and E would not increase the level of mining activity at Colstrip but would be an extension of on-going mining levels. The resultant impact to transportation over and above that already occurring would be negligible. The following information applies to the general Rosebud county area as a whole and to all the coal development-related activity therein.

Although road volumes decreased slightly between 1973 and 1974, overall traffic volumes have increased since 1970. The increase is largely due to recent coal development in the county and the expansion of I-94 to four lanes along much of its route in the county, particularly west towards Billings.

The rise in traffic volumes has resulted in several problems. Although sufficient data is not available to determine exact changes in vehicle composition, certain roads, especially those serving coal development sites, have not only had an increase in volume of traffic but also an increase in the number of trucks and other heavy vehicles. This has led to a deterioration of road surfaces.

Several key roads in Rosebud County have gravel surfaces which, with increased use, are creating significant dust problems; this is a nuisance for residents living along the road and is also having a detrimental effect on roadside vegetation. There are few direct connections between various parts of the county and a trip between two towns often involves a slow circuitous route. In the past, there has been less need for intearegional travel, but, as the region is population expands, demand for more direct or improved access will increase.

6. Recreation

Mining operations in the undisturbed portions of areas A and E would potentially reduce recreational use supply during the life of the mine. The mined areas would eventually be returned to a condition suitable for general outdoor recreation use, but availability of the land for this use is conjectural because the surface is privately owned.

Although mining of undisturbed portions of areas A and E would not directly generate the need for additional mine employment and hence would not increase recreational demand upon Rosebud County. The BLM (1976) reports that:

"The regional recreation demand for several activities already exceeds the supply. In recent years, increasing amounts of private lands have been closed to recreation use. This is partly a result of antagonism toward mining, increased numbers of recreationists, and existing or anticipated damage to land and property. Increasing recreation pressure may result in additional closures of private land."

7. Archaeological and historical sites

Seventeen prehistoric and one historic site would be destroyed by additional surface disturbance in areas A and E as proposed. Cultural resources are non-renewable; once destroyed they are lost forever.

Another form of cultural resource destruction which might occur as a result of general coal development in the Colstrip area is the uncontrolled collecting of sites adjacent to the area. This may result from the increase of people in the area.

8. Aesthetic values

a. Primary impacts

The primary landscape features of the unmined portions of areas A and E that dictate scenic character of the area are steep sloping terrain with exposed colored soils, sandstone outcroppings occurring on hill ridges and along some valley floors, scattered ponderosa pine that follow numerous ridges and slopes, riparian vegetation creating interesting patterns and textures along drainages, open grasslands, and agricultural areas. New mining operations would continue to create strong visual contrast with the existing visual resources of the unmined portions of Areas A and E and with the undisturbed areas in proximity to Areas A and E. The visual contrast between new mining and current mining operations of other existing visual modifications would be considerably less.

Mining operations create a major intrusion into the existing natural and relatively undisturbed landscape. The large equipment (trucks, bulldozers, draglines, etc.) would create an extreme contrast to existing conditions. Individual perceptions of this operation are largely divided between two extremes. Those in favor of mining are indifferent--"It's the only way to get the coal out." Those opposed to mining perceive it as catastrophic--"The entire area would be permanently destroyed." It should be noted, however, that the majority of the viewers will be mine employees and their families." (Bureau of Land Management, 1976).

Mining Areas A and E are both visible from the Town of Colstrip and from State Highway 315. No major high-volume highway or high-use recreation area is in proximity to the areas.

The strip mining process creates a sequence of visual disturbances to the natural character of the landscape. A sharp visual distinction is created between areas stripped of topsoil and undisturbed areas. The

natural color and texture of the landscape is lost during topsoil stripping resulting in a modified appearance characterized by darker colors of the subsoils and a lack of contrasting textures because of the removal of vegetation and the reduction of natural line quality previously created by defined drainages and vegetative communities. There are significant visual changes in the form and again in color and texture resulting from the mine pit and spoils piles which visually dominate when viewed in contrast with undisturbed areas.

The relatively higher visual value of the steep slopes, sandstone outcroppings and ponderosa pine and relatively lower visual value of the rolling grasslands drainage and agricultural fields are eliminated by the mining activity. However, regrading and reclamation of the mined areas to approximately the original topographic configuration and revegetating of these areas will substantially reduce the evidence of mining-caused disturbances.

At the conclusion of the mining and reclamation, the higher original visual values will be reduced significantly to lesser values and the lower original visual values will be reduced slightly but not significantly.

A contrast between the undisturbed areas and reclaimed areas will exist. A strong unnatural line character will be apparent where reclaimed areas adjoin undisturbed areas. This contrast will be evident because the reclaimed areas will be characterized by less form, texture and color variation. The reclaimed land in comparison to the original visual character will lack variety.

In comparison to BLM visual ratings, mining activity in Areas A and E will not eliminate any Class A (outstanding or rare areas), but will reduce some Class B (above average scenery) to Class C (average scenery). Some existing visual resources that rate as Class C currently will continue to be reated Class C following reclamation.

b. Cumulative environmental impacts

At the conclusion of the mining and reclamation, the higher relative visual values of the sandstone outcroppings, steep slopes, and ponderosa pine will be reduced significantly to lesser values, the relatively lower visual values of the rolling grasslands drainages and agricultural fields will be reduced slightly but not significantly. The reclaimed land will contrast with undisturbed land because the visual character of the reclaimed land lacks variety.

IV. Mitigating Measures

A. Physical Environment

1. Air quality

Engine exhaust emissions from the vehicles used at the mine are not expected to be a problem because of normal procedures of keeping engines in tune, minimizing idling time and avoiding unnecessary vehicle clustering. Fugitive dust emissions resulting from operation activities would be controlled to the fullest extent practicable by application of the following suitable mitigating techniques: (1) Roadway surfaces used for haulage would be constructed of scoria, shale, or gravel. (2) Roadways exposed to constant activity will be watered, oiled or chemically treated. (3) Mined and other disturbed surfaces would be revegetated as soon as possible to limit the amount of exposed surface area and, if necessary, these surfaces would be covered with a material such as mulch until revegetation has progressed to a point that wind erosion is no longer a problem. (4) The tippie should be covered to reduce the levels of coal dust, as done at other mines in Montana.

2. Geology

In compliance with the Montana Strip and Underground Mine Reclamation Act, WECO would do the following: (1) As mining progresses, spoil piles would be regraded to a maximum of 5:1 slopes, retopsoiled and seeded. Final highwalls would be graded to slopes not greater than 20 degrees. The final pit would be filled with material from adjacent spoil banks and highways. The final cuts, spoil banks and highwalls would also be covered with an adequate layer of soil material and seeded to facilitate revegetation. These procedures would significantly lessen the possibility of mass wasting or soil erosion, and restore the land surface to a topography similar to and compatible with its surroundings.

3. Hydrology

To mitigate possible degradation of the water quality of East Fork Armells and Cow Creeks, appropriate settling ponds would be established where any mine waters leave the permitted areas. Any discharge from the mining areas would meet the standards of the Rules and Regulations adopted pursuant to The Montana Strip and Underground Mine Reclamation Act as well as the water quality standards of the state.

Mining activities in Areas A and E would be far enough removed from the main drainage course of East Fork Armells and Cow Creeks, respectively, that direct disturbance of these stream channels and their alluvium would not occur. As mining progresses on these areas, a surface drainage system would be developed to minimize erosion and distribute runoff similar to premining conditions.

4. Soils and Overburden

Measures which reduce the impact on soil and overburden disturbances center handling methods for spoil and topsoil on replacing suitable topsoil and subsoil materials on exposed and graded spoils and methods of erosion control. These methods are aimed at reestablishing a diverse vegetation quickly, at preventing toxic effects of overburden on vegetation or animals and at preventing erosion during and after reclamation. Following are the more important mitigating measures for impacts to soils that would be carried out during the mining operation.

- (1) Coordination of the mining and reclamation activities to help minimize moving distances and storage time of topsoil.
- (2) On-site verification of stripping depths of staking would pinpoint and verify soil map predictions. This would also yield information about amounts of topsoil and to strip and replace without ending with volumes in excess or in shortage.
- (3) Movement of top and subsoil materials at optimum moisture content to help preserve soil structure.

- (4) Stabilizing topsoil and subsoil piles with grass seeding and mulches to help prevent erosion.
- (5) Materials which contain toxic elements or have a highly saline condition would be buried to a minimum depth of eight feet.
- (6) Treatment of overburden when required with limestone or gypsum to prevent release of harmful elements.
- (7) Use of regrading patterns and surface manipulation techniques to capture snow and water, and minimize runoff from regraded areas.
- (8) Fertilizing topsoiled areas as required to promote quicker revegetation.
- (9) Use of sodding techniques when necessary to promote adequate revegetative growth and increase diversity on reclaimed areas.
- (10) Construction of a surface water drainage system to minimize erosion caused by water entering the mine area.

5. Noise

Sound level contributions due to mining operations in Areas A and E are not expected to be excessive and hence, no noise mitigation measures should be necessary besides those normally implemented for protection of the mine workers. If sound levels during operation become significantly greater than estimated, then additional mitigating measures would be implemented, such as the installation of:

- (1) Mufflers on construction and operating vehicles.
- (2) Suitable baffling and attenuation facilities where warranted.

The maximum sound level from the detonation of explosives is estimated not to be of sufficient level to cause physiological harm. Although the sound from explosions would not be physically harmful, it may startle some nearby residents. To reduce this possibility, the explosions would be designed to optimize breakage and minimize sound. It is planned that blasting operations will be limited to daytime hours.

B. Biological Environment

1. Vegetation and Agriculture

Long range productivity of the areas A and E for vegetation is dependent on successful reclamation under the Montana Strip and Underground Mine Reclamation Act. According to the Reclamation Act, a permanent diverse vegetative cover is required that must be capable of sustaining itself under variable climatic conditions and withstanding grazing pressure comparable to premining. The species planted on mined areas must be dominantly native species (M.A.C. 26-210 (18)-S). In the areas A and E, some of the native species such as cheat grass, or other weedy forb species, which occur because of overgrazing are not desirable. These species should not be reestablished. In reclaiming mine land, the species required by wildlife that existed in the area previous to mining should not be eliminated during the reclamation procedure. For example, sagebrush, although not important for livestock, is important for the survival of certain wildlife species such as antelope.

The vegetation ultimately established on the reclaimed area would be dependent on the long-term climatic conditions and the soil profile developed. Under current grading practices and topsoil salvage operations, the type of soil that would probably be present is reasonably predictable. During reclamation, the soil profile would be affected by the developing plant community. Current research on old graded spoils piles that have been reclaimed by natural means, indicates that a stable community type may or may not be established depending on site specific conditions (Sindelar, Atkinson and Proctor, 1974) in a 50 year period. Thus, continued reclamation research and application to actual reclamation are of great importance.

Presently, DSL has not yet established the precise quantitative criteria for determining bond release under the Montana Strip and Underground Mine Reclamation Act. Quantitative criteria will be necessary to determine if the plant communities established are permanent and diverse, and if coverage conditions are equivalent to that prior to mining. The species of shrubs, forbs, and grasses that are necessary to sustain wildlife and livestock to the degree comparable to that prior to mining will also have to be established.

The region around Colstrip is primarily a ranching community. The grassland type vegetation provides extensive tracts of livestock forage in addition to natural sheltering areas in the creek bottoms. Ranching operations are typically large in acreage. As a result of this type of operation, intensive management procedures such as frequent movement of livestock from one pasture to another and extensive subdivision rangeland by fencing are generally not feasible because of the labor requirement. Thus, it is important that reclaimed strip mine land of the region be returned to such a state that it can be used without intensive management.

In addition, the importance of native species being reestablished on strip mined areas requires some discussion. Over many years of natural selection, vegetation has developed in the Colstrip region to its present state. These natural vegetative communities have been developed by both historic and current grazing pressure, climatic changes, and the ability of the plants to sustain themselves for many generations. Exotic species that have been established by hybrid breeding programs or imported from other countries, have generally not proven to sustain themselves over a long period of time. The most valuable function of exotic species in reclamation is to establish immediate ground cover for erosion control. Some exotic species also provide forage for livestock

under various management procedures. Problems with exotic species include their lack of palatability or desirability for livestock and wildlife, their possible inability to sustain themselves in drought conditions or other unusual climatic conditions, and the possibility of precluding ultimate reclamation to native plant species by competitive exclusion under conditions that may exist on the reclaimed areas or on adjacent or mined areas.

Native plant species cannot be expected to be immediately established on graded mining areas. However, even though the native climax range species are desirable for long-term range land productivity, they can only be established after proper micro-climatic conditions on the soil surface and environmental conditions within the soil itself are established. These conditions are usually established by an earlier successional stage of weedy species or other plants. Thus, direct seeding of native climax species into strip mine spoils may not be an effective method of reclaiming the area unless the area has proper environmental conditions already developed. The proper conditions may be achieved through natural succession or artificial means such as mulching or similar techniques.

Recent reclamation efforts have relied primarily on only seeding a mined area to prescribed seed mixtures. Future reclamation may require several steps including establishment of a proper seed bed by a temporary vegetative cover. Much more information is presently available on possible successful reclamation techniques than that which is currently being used in the area (Dalsted and Leistritz, 1973).

Mitigating the loss of ponderosa pine and some shrub communities appears more difficult than establishment of a self-sustaining, permanent, grassland type of vegetation. For these species to sustain themselves, certain soil conditions are required which would probably not be achieved

under current reclamation plans. Areas of thin soils with bedrock near the surface are required and would probably be very difficult to establish using present reclamation techniques. These areas would be more desirable for wildlife habitat than livestock production. The establishment of big sage and silver sage which are also important to wildlife species, has greater potential as these species do occur in the naturally revegetated old strip mine spoils. However, germinating these species under experimental conditions in the area have not been successful (Sindelar, Atkinson and Proctor, 1974).

Other mitigating procedures that are generally not in use include: 1) establishment of a variety of soil types by preserving rocky materials, 2) varying the thickness of different soil layers during the reclamation procedure, and 3) carefully preserving particular layers of topsoil. Such reestablishment of varied soil types would ultimately result in a variety of community types.

Mitigating the impact of the removal of agricultural land in area A could be done by requiring that level areas be established among the regraded surfaces. Current data, however, indicates that reclamation to productive cropland using normal fertilization rates might not be possible (Meyn, Sundberg, and Young, 1976).

WECO has continually expended large sums of money in the research aspect of revegetation and will probably continue such activities. Results of these experiments should be incorporated into actual reclamation plans as soon as any new method proves feasible. In particular, techniques which would allow better stabilization of soils and more immediate vegetation establishment would be desirable if they do not adversely affect the ultimate succession to native plant communities. Detailed descriptions of the revegetation experiments that have been

conducted in the area are listed in a series of technical reports and papers (Meyn, Sundberg and Young, 1976, Sindelar, Atkinson and Proctor, 1974, Sindelar, 1977, Hodder, et. al., 1972, Packer, 1974, Meyn, Holechek, and Sundberg, 1975).

In addition to establishment of vegetation production on the area, proper nutrient balance and trace element levels should be maintained in the vegetation. Available data indicates that problems may occur with deficient levels of zinc and copper in native vegetation in the Colstrip area. Legumes, including yellow sweet clover, have a tendency to accumulate molybdenum. The combination of low copper levels with high molybdenum levels could create a problem with livestock in the area. To mitigate this impact, legumes, including sweet clover, should be kept to a minimum or excluded on reclamation areas. Certain types of vegetation such as the silver sage in the area and forbs have higher concentrations of copper and zinc which may be essential supplements for livestock to make proper weight gains (U.S. Geological Survey, 1976). Although direct toxicity caused by ingesting high concentrations of molybdenum in legumes has not been established in the study area, the analytical data available for the Big Sky Mine in the nearby vicinity indicate there is cause for concern. These authors (U.S. Geological Survey, 1976) concluded the following: "It may be difficult, if not impossible, to prevent potentially hazardous geochemical environments in some surface mine operations. Though with proper management of reclaimed areas mining need not be precluded". This indicates that the reclaimed areas that have high concentrations of sweet clover and consequently molybdenum, may require special management procedures to insure that molybdenum toxicity does not occur. In addition, livestock may require supplements of zinc and copper to insure proper weight gains if they are fed solely grass species low in these essential elements (Munshower and Nueman, 1977).

The graded spoils piles research area on the northwestern portion of area E is of special concern (see Appendix F and section VIIIA).

The ultimate success or failure of reclamation may depend on continuing this research to determine why reclamation apparently succeeds naturally on certain spoils areas and not on others.

The effect of dust on short and long-term vegetative production will be reduced by ensuring that the ambient air quality regulations for particulate concentrations would be met. This assumes that the basis for determining the current ambient particulate concentration standards included consideration of the effect of dust on vegetation.

2. Wildlife and aquatic environment

In accordance with the Montana Strip and Underground Mine Reclamation Act, reclamation of surface mined areas must include establishment of vegetative cover that would support wildlife species comparable to that before mining. This necessitates establishment of forb and shrub communities required by wildlife species for cover and forage. In addition, the grading of the spoils will establish a rolling topography which provides cover and shelter similar to that which existed before mining.

Mitigating efforts for wildlife should include reestablishment of the shrub and tree coverages existing prior to mining. It will be necessary to determine the physical environmental requirements for perpetual maintenance of these species. Such conditions could then be included in the reclamation plan.

A more important mitigating measure would be reducing the disturbance of wildlife caused by increased numbers of people. WECO has attempted to reduce the occurrence of game violations in the Colstrip area by posting their surface-owned property to hunting and making it known that illegal hunting activities are not condoned (personal communication, Michael Grende, February, 1977).

In addition to Company policies, management of wildlife should be pursued on a more intensive level in the Colstrip vicinity because of the impact of the human population increases. Increased law enforcement, development of land owner/sportsman cooperative agreements for hunting access, more intensive collection of management data, and intensified wildlife management in the Colstrip area would be desirable. The increasing human population and the disruption of habitat could ultimately decrease the wildlife value of the region.

Because of the habitat lost to strip mining and the increased pressure on wildlife because of population increases, establishment of game management areas on reclaimed acreages and adjacent areas may be desirable. If successful reclamation with respect to productive wildlife habitat occurs on mined areas in the region, such areas, if primarily managed for wildlife, could provide a wildlife resource equal or surpassing that currently in existence. This would also reduce hunting pressure on locally owned land in the area.

Mitigating the impact on non-game wildlife species presents even more of a challenge, particularly for those species requiring extremely specialized habitats or those requiring a number of diverse communities. Songbirds often require a variety of community types for their existence. The reclamation of large tracts to a single community type could adversely affect these wildlife species. Total removal of the sandstone outcrops and other rocky topographical breaks will effectively reduce essential habitat for some non-game wildlife species. Reestablishment of these areas could be done by restoring sandstone rocks and providing other cover, but would be extremely expensive and unlikely under current reclamation practices.

Reestablishment of some of the shrub species in the area and the transplanting of ponderosa pine saplings into reclaimed areas is also an effective mitigating measure should such plants survive in the revegetated areas. It is, unlikely that such species would be able to continue past a single generation unless the basic physical environmental requirements are met for the species involved. This would mean an alteration of present reclamation plans to establish a physical environment similar to that existing in the areas where these plants are presently found. The landscape architecture approach of transplanting would provide at least a single generation of these types of habitat in the area and would also increase the aesthetic values of the reclaimed land.

The impact of increased sediment and decreased water quality on wildlife and aquatic environments will be reduced by ensuring that water quality standards are met.

C. Human Environment

The preparation of this draft EIS is part of the overall mitigative measures instituted for such projects as coal surface mining and major facility construction activities; such requirements are mandated by the Montana Environmental Policy Act which in turn follows many of the guidelines of the National Environmental Policy Act. Both acts attempt to establish an awareness of all aspects of a development's impact and to encourage planning to mitigate adverse impacts or to stimulate positive impacts.

1. Economics

As there are no economic impacts directly associated with the proposed action, no mitigating measures are applicable. If, however, the permit is denied, measures could be undertaken to minimize the economic loss. These could include temporary income maintenance programs, job skill training, and public assistance programs.

2. Planning

The task of planning is especially difficult in rural areas traditionally opposed to planning, and it is made even more difficult when local county and community governments and groups are forced to plan without the benefit of knowing federal, state, and often times, industry policies and intentions (Montana Energy Advisory Council, 1976). The problems inherent with this lack of direction and the need for planning at all levels is explicit in most of the studies that deal with mitigating

the impact of sudden, large developments on rural areas.^{1/} With this in mind, various agencies, the Montana Department of Community Affairs, local government, and local industry have funded or are funding planning on community facility projects at a considerable scale.

To December, 1976, Rosebud County has committed for planning activities \$98,150 which, in addition, maintains a full-time planning coordinator in Forsyth. The county also has an 11-member county-wide planning board which retains, as advisor, a professional planning consultant. The state maintains a planning office for eastern Montana, which includes the Colstrip-Rosebud County area, in Glendive; in addition, the state in 1974 furnished Rosebud County \$13,000 in Housing and Urban Development (HUD) planning funds. The latter were mostly used to fund community facility needs in the area such as a solid waste disposal system study for Forsyth and a water and sewer systems study for Ashland. The Old West Regional Commission provided the county with professional planning consultants and prepared a preliminary county general plan; a comprehensive population and economic projections computer model was also designed with this money which enables the county to quickly assess the population job aspects of any new

^{1/} For example see Northern Great Plains Coal, Conflicts and Options in Decision Making, by Upper Midwest Council, April, 1976, pp. 7-3 to 7-6, 8-17 to 8-19; Appraisal Report on Montana - Wyoming Aqueducts, U.S. Department of the Interior, Bureau of Reclamation, April, 1972, p. 26; Impact Analysis and Development Patterns related to an Oil Shale Industry, Regional Development and Land Use Study, by THK Associates, Inc., Denver, Colorado, February, 1974, pp. 920124; Large Industries in Small Towns: Who Benefits?, by Frank Clemente and Gene F. Summers, Center of Applied Sociology, University of Wisconsin - Madison, February, 1973, p. 9; Coal and Uranium Development of the Powder River Basin - an Impact Analysis, by Wyoming Department of Economic Planning and Development, June, 1974, pp. 77-8; Economic and Social Impacts of Coal Development in the 1970's for Mercer County, North Dakota, by Dr. Ralph A. Luken and Thomas E. Carroll Association, Washington, D.C., for the Old West Regional Commission, October, 1974, p. 190.

job aspects of any new developments which occur or which may be proposed in the county. Under Montana Senate Bill 87 (1975 legislature) which became effective July, 1975, the state allocated one percent of its coal tax revenue to the 56 counties of Montana on a population and area basis; these funds have been utilized by Rosebud County for purchasing planning board supplies, publishing planning documents, and in helping area soil survey analysis (fiscal data from Eldon Rice, Rosebud County Planning Coordinator, Coal Board Application, July, 1976).

One of the major mitigating factors for adverse coal-related impacts has been the establishment of an impact fund administered by the Montana Coal Board and funded by coal severance taxes.

The Rosebud County area has been designated by the state as an impact area and to date has received more than six million dollars - mostly for improvements to community facilities; the breakdown of funds by community and project is shown in table 50. Since the first of the year (1977), Colstrip has been funded an additional \$329,529 for community facilities and Forsyth has requested an additional \$245,500 for needed city equipment and water system improvements (personal communication, Frank C. Montbellier, Jr., Administrator, Montana Coal Board).

An important part of the mitigation of adverse impact accompanying extensive coal development has been the planning and community facility construction activity done by Western Energy Company at Colstrip. Even though the operations of industries in the area, such as WECO, are responsible for much of the impact on the area, there is no legal requirement that they contribute toward such mitigative measures. Cases where operating industries have not contributed are numerous and such situations have been a factor in project labor force turnover of upwards to 40 percent (Gilmore, 1975). (For comparative purposes, WECO indicates a

Table 50. -- Rosebud County projects funded by
Montana Coal Board as of December 1, 1976
(Source: Montana Coal Board, Helena, Montana,
publication, December 1, 1976)

Colstrip Elementary & High School	\$ 100,000.00
Colstrip Elementary	\$ 258,947.30
Colstrip High School	\$ 178,630.00
Ashland Public School	\$ 800,000.00
Rosebud School District	\$ 465,000.00
Rosebud County Planning	\$ 32,000.00
Forsyth Elementary School	\$2,500,000.00
Forsyth High School	\$ 27,000.00
Forsyth Water Treatment Distribution & Storage	\$ 615,000.00
Forsyth Wastewater Pumping Station	\$ 150,000.00
Forsyth Sewage Collection, Treatment & Disposal	\$ 25,000.00
Colstrip Sewage Treatment	\$ 248,000.00
Ashland Water & Sewer	\$ 71,080.00
Rosebud County Jail	\$ 100,000.00
16th Judicial District	\$ 15,000.00
Forsyth Capital Equipment	\$ 154,682.53
Sagebrush Library Federation	\$ 61,100.00
Colstrip Street Cleaning & Fire Equipment	\$ 83,000.00
Colstrip Water Treatment System	\$ 457,272.00
TOTAL	\$6,341,439.83

labor force turnover of about two percent annually (White, 1976). WECO determined that workers moving to Colstrip expected not only adequate living units such as housing, but also related factors such as landscaping and recreation facilities - when they arrived on-site. To this end, WECO provided, over time, such diverse facilities as commercial shopping space, temporary school classrooms, and a community center. Although attempting to get out of the "company town" business, WECO still assists in supporting community service facilities; for example, the company has budgeted \$70,000 this year for assisting in maintaining the community center (personal communication, Martin White, Western Energy Company).

The attempt by WECO to make Colstrip a viable community started with the funding of an initial comprehensive plan which was later refined by a team of engineers, architects, and land planners. In the process, WECO spent over \$11.6 million as shown in table 51. Recently, landowners in the community have elected an Architectural and Zoning Review Board to coordinate community growth, a process built into the community planning program by WECO through a homeowners' association and restrictive covenants provisions filed with the plats of the community.

Although considerable amount of work has been done to mitigate the adverse effects of large industrial developments in the south central areas of Montana, the total situation still needs attention; awareness of this is evidenced by such work as the Montana University System Coal Task Force Study Team, the Montana Energy Advisory Council, the Old West Regional Commission, the Rosebud County Planning Board, and others.^{1/}

^{1/} For example, see the Impact of Coal Development in the Fort Union Basin, Montana, and Neighboring State, Proposal to the National Science Foundation, Office of RANN, by the Montana University System Coal Task Force Study Team to support research, undated.

Table 51. -- Dollars expended in expanding Colstrip, Montana
Western Energy Company

(Source: Written communication, Western Energy Company,
 March 17, 1977)

Land Purchase	\$ 84,097.72
Commercial Center	1,017,435.00
Trailer Parks	1,069,084.00
Apartment Complexes	1,900,000.00
Houses	2,664,106.00
Streets, Sidewalks & Landscaping	2,050,072.95
Sewer and Water Systems	1,485,451.16
Miscellaneous Utilities	
Electric, fire hydrants, etc.	73,371.87
Home Appliances	104,914.11
Fire Fighting Equipment	3,916.22
Miscellaneous	65,737.70
Recreation	<u>1,100,000.00</u>
TOTAL	\$11,618,186.73

Note: This list excludes any costs of providing temporary housing and sewer or water systems for the construction work force. This additional estimated cost is between two and two and one half million dollars.

3. Transportation

Because of the negligible impact expected from extension of on-going mining into Areas A and E on the area's transportation system, the following applies to both the area transportation system and coal development in general.

Until recently, governments have been under serious budget constraints. Federal funds have been insufficient to meet the needs of the area, state revenues from gas taxes have been decreasing, and local governments have not had enough funds to keep up with increasing demands and rising road construction costs. One specific problem has been the need to match available federal funds with local funds, which local governments are no longer able to do on the scale that is needed; therefore, a significant source of potential funds is lost. Realizing the problems attendant with coal development, and in light of the present situation with road funding, the state of Montana in 1975 set aside ten percent of the revenues from the Coal Mines Severance Tax (estimated at the time at over \$6 million) specifically for roads in coal impacted areas. Under this program, the State Highway Department proposed improvements for a total of 310 miles in 12 various locations--the individual segments ranging from 12 to 36 miles. The first priority is Highway 315 from I-94 to Colstrip; another major segment requiring improvement is Highway 384 between Hardin and the Sarpy Creek area. The roads under this program will be brought up to secondary road standards which generally requires some relocation, elimination of sharp curves, grading, widening, and/or surfacing. The state proposed to have this work done over a period of five years. The state is also trying to find some way for these funds to be used as matching funds for federal assistance (Rosebud County Comprehensive Plan, 1975).

As of the preparation of this report, the following stages of construction were reported for FAS Highway 315 beginning one mile south of Colstrip and extending north to I-94 (oral communication, Chad Ludey, Montana Department of Highways).

M.P.	0.0 to	6.0	Design Stage
M.P.	6.0 to	17.0	Survey Stage
M.P.	17.0 to	22.0	Reconnaissance Stage
M.P.	22.0 to	30.0	Design Stage

Appendix E provides detailed information on the present status, and planned improvements for all major roads in the county.

4. Archaeological sites

Seventeen archaeological sites would be affected by the proposed additional coal mining activity in areas A and E. However, if these sites are evaluated and their scientific data salvaged, the loss is not significant. Of the seventeen prehistoric sites, five are recommended for test excavation and the remainder for controlled surface collection. On lithic scattered areas, a controlled or systematic surface collection can often produce more meaningful data than subsurface work.

The historic site should be completely photographed and recorded. In this manner it would be preserved through documentation.

Mining personnel should be alerted to watch for any buried material that was not noted in the cultural resource inventory. These materials such as charcoal, bone or chipped stone artifacts may be exposed during the removal and stockpiling of the topsoil. If such material is uncovered, project officials should contact an appropriate archaeological research agency.

5. Recreation

No mitigating or compensating measures, other than those elaborated on under Required Measures and Possible Additional Measures in the Environmental Analysis Record #1791, March, 1976, prepared by the Bureau

of Land Management, are proposed.

6. Aesthetics

Scenic quality on reclaimed areas can be enhanced through "required measures" and "possible additional measures" as elaborated on in the Environmental Analysis Record #1791, March 1976, prepared by the Bureau of Land Management. Other mitigating measures that should be considered to reduce visual impact and, therefore, enhance reclaimed areas include:

Recontouring in certain areas where erosion control is feasible should be steeper to more closely resemble original topography.

Controlled land use diversity should be allowed on reclaimed lands to create scenic characteristics compatible with the surrounding area.

V. Irreversible and irretrievable commitments of environmental resources

In this draft EIS the phrase "irreversible and irretrievable" is considered to be essentially synonymous with "consumed". Resources include not only the materials and labor required to mine the coal but also the natural and cultural values that may be lost as a result of the project implementation. Some of the resources will be "used" rather than consumed in that at completion of the project some salvage and reuse of resources are possible.

A. Physical environment

There will be no irreversible or irretrievable commitment of air quality. The air will be "used" in that some degradation will occur during the life of the project, but upon completion the air quality will return to its normal state and the project will have no lasting effect on it.

On about 1,200 acres of mined area the existing topography, soil profile and overburden will be irreversibly altered by implementation of the proposed action. During the life of the project, approximately 250 to 450 acres will be committed to mining use at any one time in each of Area A and E and would not be available for agricultural use. Availability after mining would depend on the rate and success of WECO's reclamation efforts.

Approximately 39 million tons of Rosebud coal would be mined in the two areas which, once consumed, would be irretrievable. This amount of coal represents about 0.12 percent of the strippable coal reserves of the Tongue River Member in southeastern Montana. As a result of the mining procedure, about 2 million tons of Rosebud coal would be left as cleanings and unmined wedges within the mine area, essentially irretrievable. In total, somewhat more than 95 percent of the in-place coal is recovered during mining.

The energy needed for the production of coal at Colstrip includes diesel fuel for the crawler and rubber-tired equipment and electricity for the draglines, shovels, large drilling equipment and coal handling equipment. The energy needed to produce one ton of coal was found to be:

$$\begin{array}{rcl} \text{Diesel fuel} - 0.285 \text{ gal/ton of coal} & = & 40,000 \text{ Btu} \\ \text{Electricity} - 4.7 \text{ KWH/ton of coal} & = & \underline{16,000 \text{ Btu}} \\ & & 56,000 \text{ Btu} \end{array}$$

Because WECO ships coal to several different consumers, transportation energy costs were averaged. For the purpose of this analysis, it was assumed that an average weighted round trip was approximately 1,500 miles. It was estimated that 600-800 Btu were required to transport one ton of coal one mile. Transportation energy costs would then be 900,000 - 1,200,000 Btu/ton of coal. The total of the main energy costs for coal production and transportation is approximately 956,000 - 1,256,000 Btu per ton of coal.

Assuming Colstrip coal averages 8,600 Btu/lb., each ton of coal has approximately 17,200,000 Btu. Then:

$$\begin{array}{l} \text{Energy consumed as percent of energy produced} = \\ \text{(using higher figure)} \quad \frac{1,256,000}{17,200,000} \times 100 = 7.3\% \end{array}$$

Surface and ground-water resources of Mine Areas A and E will in large part not be available for other potential uses during the life of the project. The mine excavation dewatering will preempt some of the adjacent area stock or domestic use of ground water from the Rosebud bed and above. After the project, the Rosebud will be absent, but depending on the quality of the water in the replaced spoil materials, some of it may be available for use. Wells may be successful in areas where the resaturated overburden contains large amounts of sand. The deeper

ground-water regime, below the mined area, should not be affected by the mining operation. Likewise, surface water will be available for use following reclamation of the mined lands.

B. Biological environment

The native vegetative communities' diversity and variety would probably be irreversibly committed upon mining. The complete change of the soil profile and the elimination of rock outcroppings, and the variety of conditions that presently exist can be considered irreversible, once the mining begins.

Until reclamation success becomes more defined, the long-term maintenance of the original productivity of the land is questionable. This could ultimately mean a decrease in the productivity in the mined areas for an indefinite period for either wildlife or livestock. Wildlife habitats dependent upon unusual conditions or diversity could be permanently lost. The graded spoils research areas on the northeast portion of area E will also be permanently lost once mining has commenced. An associated impact resulting from human activity and coal conversion plant emissions would also undoubtedly permanently alter the vegetation in areas A and E.

C. Human environment

The continued mining in Areas A and E represents the loss of that labor and capital to other areas. However, the proposed action does not represent any additional commitment of human resources beyond that which is currently being used.

The elimination of sandstone outcroppings, and vegetative diversity of original topographic contours is an irreversible commitment from an aesthetic standpoint because the original visual resource can never be duplicated. The reduction of the quality of the visual resources of viewing Areas A and E would not, however, eliminate any outstanding or rare visual resources.

The destruction of archaeological and historical resources is an irreversible commitment because such resources can never be duplicated. In the strict sense the archaeological excavation or salvage of a cultural resource is an irretrievable commitment. However, the data obtained in salvage are contributions to knowledge which could not be obtained otherwise, and as such produce benefits which offset the commitment.

VI. Relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity

This section contains a discussion of the relationship between the local short-term uses of the environment surrounding Mine Areas A and E in terms of the potential exclusions or restrictions of any long-term uses. Short-term impacts, including benefits, are defined as those that occur during the development and operation of the project. Long-term productivity is that which may occur after the project is no longer in use.

A concept to be kept in mind while reading this section is that the proposed project is a short-term solution to present problems and, by virtue of its nature and size, it will have some cumulative long-term adverse effects on the environment. These effects must be assessed in relation to the short- and long-term beneficial effects that will occur, both in the project area as a result of project activities and in market areas as a result of the utilization of the additional energy supply by the consuming public, should the project be implemented.

A. Physical environment

1. Air quality

A short-term degradation of air quality would occur in the mine areas during the operation due to the increase in dust emissions and minor amounts of gaseous emissions from the operation of equipment and vehicles. Based upon state and federal ambient air quality standards, the deterioration of air quality is expected to be within acceptable limits except possibly locally under unusually stable atmospheric conditions or immediately adjacent to mining equipment. With successful revegetation, fugitive dust emissions would be eliminated and air quality should return to normal. No long-term significant reduction of air quality should result from the project.

2. Topography, geology, soils

The topographic geologic, and soil impacts that last beyond the life of the project should for the most part, be of minor significance. Short-term effects include destruction of existing topography, soil profile and sedimentary rocks on about 1,200 acres of mined land and disturbance of the surface on about 660 associated acres adjacent to the active mine areas.

During the life of the project various amounts of resources will be used. Approximately 30 million tons of coal would be mined for energy conversion purposes and supplied to state and interstate markets. In addition, various amounts of construction materials would be used including the mining equipment. With the exception of salvaging portions of steel, copper, aluminum, etc., the mineral resources committed to this project would be lost to future use.

Following termination of the project it would be possible to explore for and develop any other mineral deposits which remain in the project area (including the remaining coal that may become economically feasible to recover at a future date). Clinker which cap the uplands in the mine areas would be removed during mining and used in road construction and maintenance. Therefore, it would not be available for future use.

Because of the overall good quality and substantial amounts of topsoil and subsoil on Areas A and E, the chances of successful reclamation enhanced compared to other mine areas. In the short-term, as a result of reclamation procedures, which include fertilization and mulching, productivity will likely be increased somewhat over present production. Over the long-term, soil productivity may be about equal to that which already exists. The net effect of mining and reclamation activities could increase the actual area of productive soils because areas which are currently rock outcrop areas would, after reclamation, be reclaimed with topsoil.

Long-range productivity would depend largely on the type of vegetation established, and its care.

3. Hydrology

During the life of the project the total volume of runoff to East Fork Armells and Cow Creeks would be slightly reduced as the result of impoundment of runoff by sediment retention ponds. It is uncertain whether the sediment retention structures would be removed following termination of the project. If they are not, the slight reduction in runoff volume to East Fork Armells and Cow Creeks would continue. This would not be a significant loss.

If all of Area A is mined beyond that proposed, then two storage resevoirs would be removed and two others possibly would have a reduced storage capacity. Following mining these structures could be replaced.

Assuming ground water seeps into mine pits A and E at an average rate of 200 cubic feet per day and 50 cubic feet per day, respectively, then approximately 20 acre-feet of ground water will be removed during each year of mine operation. Most of this water would essentially be consumed by project operations. Following completion of the mine operation, the ground-water system should restore itself to approximate premining conditions. In accordance with the current mining plans for Areas A and E, only 1 existing well in Area E would be destroyed. Should the remaining portions of Area A and E mined, 4 additional wells in Area A would be destroyed and possibly 1 or 2 others would have reduced yields. These wells could be re-established after mining.

The water quality of East Fork Armells and Cow Creeks would be dependent on the influence of the quality of the groundwater seepage. There may be a slight increase in total dissolved solids concentrations in these Creeks near the mine areas caused by the inflow of groundwater

from the mined area. Any degradation of these streams from this source would probably be negligible. In terms of long-term productivity the ground water in the project area may be slightly degraded in some mined areas above the base of the Rosebud coal. Ground water in aquifers below the coal bed should not be affected significantly, if at all, following completion of the mining.

B. Biological environment

Obvious short-term costs of the proposed mine in Areas A and E are the elimination of the agricultural land in Area A for crop production and the elimination of the remainder of the land for use by livestock and wildlife species. The elimination of these uses would continue for the duration of the mining activity and until reclamation of the land has been completed. The long-term use of the land ultimately would be for agricultural production and recreational pursuits such as hunting and other activities dependent upon the wildlife species. The short-term removal of minerals would provide an energy resource that is currently in high demand.

Coal is not a renewable resource and once removed, would never again be available for future uses. Thus, strip mining coal can be considered a short-term event. The ultimate rate of use by man, the extent of coal deposits, and the economics of removal will determine the total length of time any mining activity will continue in the region.

Under present economic conditions and national priorities, the demand for coal greatly exceeds that of the agricultural products raised in the Colstrip area. In the long-term, coal would ultimately be replaced by other sources of energy with a low probability of exhaustion.

C. Human environment

1. Economics

The proposed actions for areas A and E would maintain the current economic environment and, through income and employment opportunities, it will preserve the general economic well-being of the residents. It will also prevent the disruption and loss of resources caused by unemployment.

2. Recreation

The long-term productivity of areas A and E for public outdoor recreation use is conceivable following reclamation but is not feasible because the areas are in private ownership.

3. Land use

The issue of the relatively short-term surface mining of coal and the long-term productivity of the land is an important one in assessing overall impact; however, this issue must be weighed by examination of all aspects of EIS because of the characteristics inherent in a land use change.

4. Aesthetics

Initially, aesthetics would be sacrificed in order to extract needed coal, however, this would be short-term assuming that reclamation would be successful. Assuming that successful reclamation is achieved and that a diversity of land uses is possible in time, the final visual characteristics of mining areas A and E, while never being able to duplicate the original visual character, would eventually be visually compatible with the surrounding area.

VII. Description of Alternative Actions

A. Administrative alternatives available to the Department of State Lands

1. Refusal of permit under the Montana Strip and Underground Mine Reclamation Act.

Under Section 50-1042(1), R.C.M. 1947, the Department of State Lands may not approve an application for a strip mining permit if

"there is found on the basis of the information set forth in the application an on-site inspection, and an evaluation of the operation by the Department that the requirements of the act or rules will not be observed or that the proposed method of operation, backfilling, grading, subsidence stabilization, water control, highwall reduction, topsoiling, revegetation or reclamation of the affected area cannot be carried out consistent with the purpose of this act."

Denial of the permit may not be possible legally by the Department unless it could establish that reclamation is not possible or that other requirements cannot be met. The only available information addressing recent reclamation trends indicates that diversity is decreasing in some of the reseeded areas with time, but plant cover is achievable (Dusek and McCann 1975). Whether this constitutes reclamation failure is subject to more detailed legal interpretation. The long-term establishment of vegetation in the 1932 research area would, however, indicate that ultimately reclamation could be successful in some areas. However, the length of time necessary to establish a permanent, diverse community of predominately native species is not known.

Denial of the permit amendment for areas A and E would mean that WECO would continue to mine under their existing permits for areas A, E and B. The recoverable coal able to be mined under these permits is limited, however, and WECO would soon be required to submit new permit or permit amendment applications in order to meet contract demands. Denial of this permit would eventually have an adverse effect on the viability of Colstrip electrical generation units 1 and 2 and proposed

units 3 and 4. The ultimate result of further permit denials would be the loss of Colstrip-related employment and the termination of the Rosebud mine as a source of low-sulfur coal. Montana Power and the midwestern power companies would have to seek other sources of such coal.

2. Refusal of permit as to certain lands included within an application for permit under the Montana Strip and Underground Mine Reclamation Act

Under Section 50-1042(2), R.C.M. 1947, the Department of State Lands may not approve an application for a strip-mining permit where the application includes lands having special, exceptional, critical, or unique characteristics, or where mining on the area would adversely affect the use, enjoyment, or fundamental character of neighboring land having special, exceptional, critical, or unique characteristics. Under Section 50-1042(3), R.C.M. 1947, the Department must delete from a permit land with overburden such that

"experience in the state with a similar type of operation upon land with similar overburden shows that substantial deposition of sediment in streambeds, subsidence, landslides, or water pollution cannot feasibly be prevented . . ."

Section 50-1042(4), R.C.M. 1947, provides that if the Department finds that the operation proposed would constitute a hazard to a dwelling house, public building, school, church, cemetery, commercial or institutional building, public road, stream, lake or other public property, it must delete those areas causing the hazard from the permit. This section of the law allows for the consideration of denying a permit for those areas which meet stated criteria.

An evaluation of the existing research areas should be made to determine their scientific value and whether or not equivalent information can be gathered from adjoining areas. Current studies in the area are complete or nearly so, and new studies are not planned. If more studies are necessary, they should be conducted as soon as possible to insure that all scientific values are salvaged from this area before it is mined.

In addition to the proposed delay or deletion of mining in the spoils research area, restrictions could be considered on mining the areas of ponderosa pine stands in both areas A and E. This would be done under the assumption that such areas are ecologically fragile and reestablishment of these communities in the area under current reclamation practices has not been promising. This alternative would basically prohibit mining in the proposed area A and possible in area E as the avoidance of these ponderosa pine and associated shrub areas would be very difficult under current mining plans. Although these areas are not unique to the Colstrip area, restoration is questionable. Under current interpretation of Section 50-1042 of the Strip and Underground Mine Reclamation Law, such areas as the ponderosa pine in this region are not considered ecologically fragile, although there is question as to whether permanent establishment of ponderosa pine can be done with current reclamation procedures.

Other alternatives or variations in the permit could also be considered. These could include preservation of sandstone rock outcroppings, as they will not again be restored to provide habitat for certain non-game

wildlife species, modifying the reclamation plan to insure increased mulching of areas, and using variable techniques in establishment of vegetation.

Virtually all these alternatives will increase the cost of reclaiming the area and are based on what would be desirable primarily from the wildlife viewpoint. Such actions may be necessary in the future depending on present reclamation success.

3. Approval of a modified mine and reclamation plan for lands included within an application for permit under the Montana Strip and Underground Mine Reclamation Act

The Department of State Lands may approve mining and reclamation plan modifications that meet the requirements of the Montana Strip and Underground Mine Reclamation Act or the Department's rules adopted pursuant to the Act. DSL, for example, could approve a modified mining plan for area E whereby mining in the northeast portion of area E would be delayed until additional research activities on graded spoils are completed.

4. Disapproval of strip-mining plan under the Montana Strip Mined Coal Conservation Act

After a strip-mining plan is submitted to the Department under the Strip Mined Coal Conservation Act, the Department has six months to review the plan to determine whether waste, as defined in the act, would occur. If so, the plan must be disapproved; otherwise, it is approved. If the Department fails to make the required determination within six months, the plan is deemed approved. If a plan is disapproved, the Department must recommend means by which to bring the plan into conformance with the Act.

B. Technological Alternatives

1. Other sources of coal

Other potential sources of low-sulfur steam coal would be other Montana or Wyoming strip mines. Midwestern purchasers could possibly obtain high-sulfur Illinois or Appalachian coal and process the coal to remove much of its sulfur content prior to burning. In addition, improved design of power plants may reduce air pollution problems. Low-sulfur coals from Illinois and Appalachia are used, almost exclusively, for metallurgical processing.

Other alternatives to reduce the total amount of coal required for both Units 1 and 2 as well as for existing and future power plants exist.

One demonstration of this is the power plant in Midland, Michigan. Waste heat, instead of being wasted, is cycled into the adjacent Dow industrial plant for use as process heat. This eliminates some of the industrial energy demand that would exist were the plant located elsewhere. At Colstrip, excess heat from the generating plant, as well as water vapor, is lost to the atmosphere from cooling towers. Were this heat to be utilized, it would reduce the need for withdrawing water from the Yellowstone, as well as reducing the need for electrical generation.

2. Underground mining

The major advantage of underground mining is that there would be little disturbance of the stratigraphic layers except for the removal of the coal itself. Surface subsidence would occur at Colstrip because "caving" is an integral part of underground coal mining. For every 10 feet of coal removed, 100 feet of overlying strata are disturbed by caving.

Frequency rates for both fatal and non-fatal accidents for underground and strip mining are controversial depending on whether one takes into account BTU's of coal mined or tons of coal mined or man-hours spent mining. Roof falls and coal falls caused by the low-bearing strength of the overlying strata and faults cause many accidents; however, most fatalities due to roof falls are related to carelessness on the part of the miner. Accidents in underground mines are also caused from gas and dust build-ups. Many of these accidents, however, could be avoided were proper safety precautions observed. Also, the long-term hazards from inhalation of coal dust and radio-active particles (in western coals) are great.

The Russians, English and French have developed methods for mining thick (16-24 feet) coal seams with recovery rates to about 80%. But these are applicable to deep seams with stable roof conditions. Recovery rates using conventional and longwall underground mining average 55%, but using these methods on very thick seams would probably reduce this recovery rate. Strip mining has a recovery rate of 95% and even with the excluded areas (buffer zones, etc), recovery rates average 90% (Finch, 1974).

Skilled manpower for an underground mine must be obtained either through importing qualified workers or training existing unemployed Montanans. Underground mines require ten times the manpower required by a strip mine. This and the greater capital expenditures makes the final sale price for underground mined coal about seven times that of surface mined coal.

3. Contour, auger and in situ mining

Contour mining is prohibited by the Montana Strip and Underground Mine Reclamation Act.

Auger mining would recover about 10% of the coal resource. This

would result in a waste of virgin coal seams because auger mining renders them unsuitable for mining by any other method.

In situ mining, used in the mining of sulfur, potash, and uranium, is a method in which super-heated water or another solvent is pumped into an ore-body and then the resource bearing solution is withdrawn and processed. This method is probably not feasible for coal. There appears to be little technology today to determine whether the coal seams are sufficiently friable to be pumped from the underground as a slurry.

Most major companies would probably prefer to use either the Yellowstone or its tributaries as their water sources for slurry mining. In addition, if their slurry were to be transported by pipeline, much of the state's water resources would be completely lost. Given the agricultural and wildlife needs of the limited amounts of water Montana possesses, the feasibility of a slurry pipeline is highly questionable.

No markets for slurry are currently available. Were a market to develop, waste waters, such as those from industrial discharges, could be used in the slurry, as these waters are unfit for aquatic ecosystems, wildlife or agriculture. The other alternative water source would be the East.

Damage to aquifers and other subsurface structures by in situ mining is unpredictable. In situ gasification is still a research concept and not an available alternative (Finch, 1974).

4. Utilization of other forms of energy

Other fossil fuels such as natural gas and petroleum are in more limited supply than coal. Oil shales and tar sands are only available on a small scale and are thus not an available alternative at this time.

Nuclear power has encountered technical difficulties in providing adequate safety precautions. Public reaction has also been slowing its development.

Solar, geothermal and wind energy converters are still experimental or pilot plant scale operations. While such sources show promise, their large-scale utilization is still a few years away. However, if as much energy and time were applied to solar development as is being applied to coal development, the feasibility of conversion to alternative energy may be greatly improved.

The feasibility of attaching wind-generating systems to power plants should be addressed. A comparison by Obermeier (1976) of wind speeds at thirteen locations in Montana indicate that locations in eastern Montana and the east slopes of the Rockies have the greatest potential for supplemental power generation. Obermeier also feels that the power generation potential for the Powder River Basin (in which Colstrip is located) is similar to that at Miles City (his closest data point). Hence, the question must be asked: Why not build supplemental wind generators with power plants? Obermeier also points out that large scale wind electric generation requires no water.

Hydroelectric generation facilities in this country have utilized almost all available sites. Many hydroelectric dams have had additional power houses built.

Montana is, basically, an energy intensive state. The land area relative to the population clearly indicates this. Distances between places are great and hence more energy is required for movement of goods and people than for an equivalent population located elsewhere (e.g. Boston, proper). Distances rapidly reduce the energy efficiency of anything done in the state, be it exporting coal or importing goods. As a consequence, the cost of numerous goods and services are higher here than elsewhere. As the energy crisis becomes more serious, energy costs are going to soar (supply vs. demand). When this happens, the cost of living (particularly in an energy intensive state like Montana) will

soar, too. At this point, alternative energy resources will certainly be feasible, and may in fact be less costly than building power lines across large uninhabited areas of the state (the distances). This makes it imperative that the wastage of solar and wind power (by not using them), the loss of excess heat from electrical generation, and other energy inefficiencies be reduced or eliminated.

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IX. Other agencies contacted for information

Montana Bureau of Mines and Geology

Montana Department of Community Affairs

Montana Department of Highways

Montana Department of Health and Environmental Sciences

Montana Department of Natural Resources and Conservation

Montana Department of Revenue

Rosebud County Planning Board

X. Individual contributions to the preparation of the impact statement

Cummin Associates. Billings, Montana

Dames & Moore, Consultants. Billings, Montana

Olson-Elliott and Associates. Helena, Montana

Hayden, Brace. Environmental Coordinator, D.S.L.
B.S., Agricultural Economics, 1969, University of
California (Davis)
M.S., Resource Conservation, 1975, University of
Montana

Johnson, Sandra. Environmental Planner, D.S.L.
B.A., Biology, 1973, Mt. Holyoke College
M.A., Plant Ecology, pending, University of
Montana

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